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The Aleyrodidae (Hemiptera: Sternorrhyncha) of the Canary Islands with special reference to *Aleyrodes, Siphoninus,* and the challenges of puparial morphology in *Bemisia*

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Cover photo caption: Puparia of the spiralling whitefly, *Aleurodicus dispersus* Russell, with wax secretions in perfect condition, ex- Santa Cruz de Tenerife. Photographed alive by Harry Taylor, Photographic Unit, BMNH.

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Abstract

The whitefly fauna of the Canary Islands (Spain) comprises 21 named species distributed amongst 12 genera, including four species described here—*Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov.**, *Aleyrodes laurisilvae* Hernández-Suárez and Martin **sp. nov.**, *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov.** and *Bemisia reyesi* Hernández-Suárez and Martin **sp. nov.** Nomenclatural changes comprise the four new species, one revalidated species (*Siphoninus finitimus* Silvestri **stat. rev.**), and two **revised synonymies** (*Siphoninus phillyreae multitubulatus* Goux becomes a junior synonym of *S. finitimus* Silvestri and is removed from synonymy with *S. phillyreae* (Haliday), and the genus *Bemisiella* Danzig becomes a junior synonym of *Asterobemisia* Trehan; both the latter genera are removed from synonymy with *Bemisia* Quaintance & Baker). Also, we have provided detailed discussions and illustrations of eight distinctive puparial forms of the *Bemisia afer* complex with scanning electron microphotographs (SEMs), line drawings and habitus photographs. In addition to the taxa described and discussed here, there are two **new records for the Canary Islands**, *Dialeurodes citri* (Ashmead) and *Paraleyrodes minei* Iaccarino. For each of the species already known and named prior to this study we include a brief account including its world distribution, its host-plant range in the Canary Islands, and further notes on host range beyond the Canaries. The general puparial morphology of each species is illustrated with a combination of line-drawings and habitus photographs. Three appendices are provided—a check list of Canarian whiteflies, a table of host plants of whiteflies in the Canary Islands, and lists of examined material for the whitefly species already known and named prior to our study.

Resumen

La fauna de moscas blancas de las Islas Canarias (España) está compuesta por 21 especies distribuidas en 12 géneros, incluyendo 4 especies que se describen en el presente trabajo—*Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov.**, *Aleyrodes laurisilvae* Hernández-Suárez and Martin **sp. nov.**, *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov.** and *Bemisia reyesi* Hernández-Suárez and Martin **sp. nov.** Los cambios nomenclaturales comprenden las cuatro nuevas especies, la revalidación de una especie (*Siphoninus finitimus* Silvestri **stat. rev.**), y la revisión de dos sinonimias (*Siphoninus phillyreae multitubulatus* Goux pasa a ser sinónimo posterior de *S. finitimus* Silvestri y por tanto deja de ser sinonimia de *S. phillyreae* (Haliday) y el género *Bemisiella* Danzig pasa a ser sinónimo posterior de *Asterobemisia* Trehan dejando por tanto de ser sinonimia de *Bemisia* (Quaintance & Baker). Por otro lado se proporcionan discu-

siones detalladas e ilustraciones con el microscopio electrónico de barrido (SEM), fotografías del hábito y dibujos, de ocho formas dentro del complejo *Bemisia afer* (las cuales han sido incluidas bajo el término *Bemisia afer sens. lat.* formas A-H en nuestro trabajo) que no hemos nominado como nuevas especies por las razones expuestas. Además, *Dialeurodes citri* (Ashmead) y *Paraleyrodes minei* Iaccarino suponen dos nuevas citas para las Islas Canarias. Para cada una de las especies citadas en trabajos anteriores al nuestro, se aporta una breve reseña que incluye la distribución mundial y rango de plantas hospederas dentro y fuera de las Islas Canarias. En general, la morfología se ilustra con una combinación de dibujos y fotografías. Por último, se aportan tres apéndices que incluyen el catálogo de las especies de moscas blancas de Canarias, la tabla de plantas hospederas para cada una de las especies de moscas blancas presentes y un listado de material examinado de todas aquellas especies citadas para el archipiélago con anterioridad a este estudio.

Key words: whiteflies, Aleyrodidae, *Bemisia afer*, *Siphoninus*, *Aleyrodes*, Canary Islands, puparial taxonomy

Specimen depository abbreviations

BMNH—Natural History Museum, London, UK.
FERA—The Food and Environment Research Agency, York, UK.
ICIA—Insect Collection, Instituto Canario de Investigaciones Agrarias, Tenerife, Canary Islands, Spain.
TFMC-ENTOMO—Colección de Entomología del Museo de Ciencias Naturales de Tenerife, Canary Islands, Spain.
MNCN—Museo de Ciencias Naturales de Madrid, Madrid, Spain.
USNM—U.S. Department of Agriculture, Beltsville, Maryland, USA (custodians of the Sternorrhyncha collections of the U.S. National Museum of Natural History / Smithsonian Institution, Washington D.C.)

Introduction to the Canary Islands

The Canary Islands are a volcanic archipelago of seven islands and four islets. Although part of Spain politically, they are situated in the eastern subtropical north Atlantic (27º37´ to 29º27´N; 13º20´ to 18º20´W) near the Western Sahara region of mainland Africa (Fig. 1).

The whole Canarian archipelago experiences a broadly Mediterranean climate with hot, dry summers and warm, wetter winters, but there is a pronounced ecological heterogeneity. Whereas Fuerteventura and Lanzarote, the easternmost islands of the Canaries, exhibit a semidesert-like climate and vegetation, the western islands of Gran Canaria, Tenerife, El Hierro, La Gomera and La Palma exhibit particularly marked altitudinal zonation, strongly differentiated between the windward and leeward sides of the islands (Fernández-Palacios & de Nicolás, 1995).

Traditionally the Canaries have been regarded as belonging to a distinct biogeographic unit known as Macaronesia, which also includes the volcanic archipelagos of Azores, Madeira and the Salvage Islands (Fig. 1), along with the Cape Verde group further to the south, all situated in the North Atlantic Ocean between 15º and 40º N (Hansen & Sunding, 1993). More recently the concept of Macaronesia is being questioned on the basis of evidence in the pteridophyte and bryophyte floras of the island groups (Vanderpoorten *et al.*, 2007).

The Canarian archipelago's vegetation comprises distinctive floral elements, such as the laurel forest ("laurisilva"), traditionally considered a relict of an ecological zone that existed in the Mediterranean basin during the Miocene (Médail & Quézel, 1997). With a rich flora of about 2000 vascular plant species, a particularly high number of endemics occur, representing approximately 40% of the native flora of the islands (Santos-Guerra, 1999; Francisco-Ortega *et al*., 2000), thus making the Canary Islands an important floristic area for conservation within the European-Mediterranean climatic region (Médail & Quézel, 1997). The laurisilva (termed *Pruno hixae-Lauretea novocanariensis* by Rivas-Martínez *et al.*, 2002) is found on the northern slopes of the islands, which are under the direct influence of the humid and cool northeastern trade winds, receiving up to 1000 mm of rainfall per year (Fernández-Palacios, 1999).

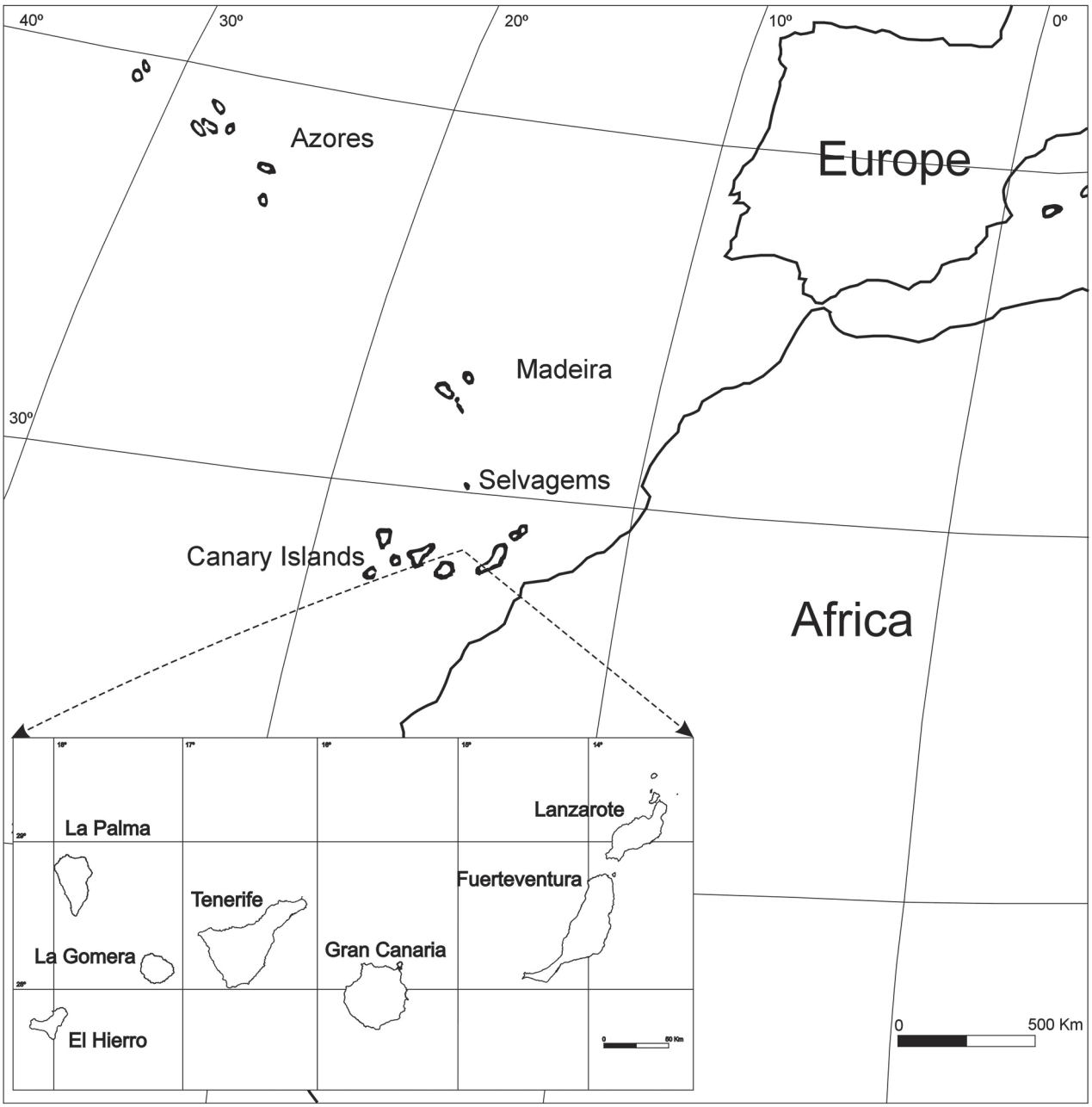

FIGURE 1. Map of the northern Atlantic Ocean showing the positions of the northernmost Macaronesian archipelagos and the Canary Islands.

The study of Aleyrodidae in the Canary Islands

The family Aleyrodidae (Hemiptera: Sternorrhyncha) includes 1556 species in 161 genera (Martin & Mound, 2007) and some are major agricultural pests. The whitefly fauna of many countries of the world is poorly known and the biology and ecology of only a few species have been studied (Martin, 1987).

The aleyrodid fauna of the Canary Islands has been only partially reported previously, and many of these publications dealt only with whitefly pest species of crops or ornamentals. Gómez-Menor (1954) provided the first account of whiteflies in the archipelago, reporting the presence of *Aleyrodes proletella* (L.), *Trialeurodes vaporariorum* (Westwood) and *Aleurotulus nephrolepidis* (Quaintance) [reported as *Aleurotulus filicium* Goeldi], as well as describing *Bemisia medinae* Gómez-Menor from the laurisilva of Tenerife.

Russell (1965) described *Aleurodicus dispersus*, a neotropical whitefly that had been introduced into the Canaries, and she listed paratype material from *Schinus terebinthifolius* from Gran Canaria in addition to an extensive list of paratypes from the New World.

An economic account covering Spanish whitefly species that included some Canarian records was provided by Llorens-Climent & Garrido-Vivas (1992). They included *Aleurothrixus floccosus* (Maskell) as a pest of citrus and ornamentals in the archipelago; Mound & Halsey (1978) had earlier listed this species from the Canary Islands, that record based on material collected in 1937 and deposited at the Natural History Museum, London (BMNH).

It is perhaps surprising that the cosmopolitan pest *Bemisia tabaci* (Gennadius) was first recorded in the Canaries, from Lanzarote Island, as recently as 1988 (Carnero & Pérez-Padrón, 1988). Two years later it was recognised as a horticultural pest throughout the Canaries (Carnero *et al*., 1990). Nevertheless, material present at the MNCN, Madrid, collected in the Canaries by Gomez-Menor in the 1960s, has now been determined as *B. tabaci* (Hernández-Suárez, 1999). The Mediterranean biotype of *B. tabaci* has probably been present for many years without causing significant damage to crops, and had thus escaped detection. It was probably the notorious "biotype B" that Carnero & Perez-Padrón (1988), noticed causing "silverleaf" symptoms in cucurbitaceous crops.

Records of *Parabemisia myricae* (Kuwana) and *Siphoninus phillyreae* (Haliday) were published for the Canary Islands by Anonymous (1997) and by Peña (1994), respectively.

Aleurodicus floccissimus (Martin *et al*., 1997) was described from Tenerife (as *Lecanoideus floccissimus*), clearly being another introduction from the neotropics, and possibly having evaded earlier detection in the Canaries by being mistaken for *A. dispersus* (see figs 86–91).

Acaudaleyrodes rachipora (Singh, 1931) and *Trialeurodes ricini* (Misra, 1924) were recorded from the Canary Islands in an appendix to Martin *et al*. (2000), based on material in BMNH and ICIA, collected as part of this study.

Aleurotrachelus atratus Hempel, now becoming a widespread pest of palms in many parts of the world, had reached the Canary Islands by 1998 and was reported by Hérnandez-Suárez *et al*., 2003.

More recent collections of whiteflies, particularly from indigenous plants, have been made by Hernández-Suárez (1999, unpublished thesis data), and by Martin (BMNH). An Azores / Canaries / Madeira Macaronesian check list was presented as an appendix in Martin *et al*. (2000: 448) and in Hernández-Suárez & Oromi (2004). Christopher Malumphy (FERA, UK) has also surveyed Sternorrhyncha in Gran Canaria in recent years and his data are also included here.

The purpose of the present paper is to provide a comprehensive account of the whiteflies of the Canary Islands, including the descriptions of two new species of *Bemisia* and two new species of *Aleyrodes* collected during recent surveys. Studies have indicated that Silvestri's (1915) *Siphoninus finitimus* should be reinstated as a valid species (**stat. rev**.), with Goux's (1949) *S. phillyreae multitubulatus* becoming its junior synonym (revised synonymy)—see Valencia (2011) and our discussion of *S. finitimus*. We also discuss in detail eight morphological forms of the puparia of *Bemisia afer sens lat*.. Variation in these forms is extreme and noteworthy but its taxonomic significance remains uncertain. Less notable forms of *B. afer sens lat*. are not treated in such detail.

Materials, methods and terminology

This study is largely based on new material collected in the Canary Islands archipelago from 1996 to the present, while incorporating previously recorded material referred to above. Specimens in the BMNH and material deposited in the Museo Nacional de Ciencas Naturales in Madrid (MNCN) have also been studied. As well as sampling adventive herbs, crops, ornamental shrubs and trees and cultivated fruit trees, particular attention was also paid to the extensive native flora, which had been almost entirely neglected hitherto.

Puparia were collected whilst still attached to leaf tissue and kept dry in transit to the laboratory for preparation. Adult whiteflies, conversely, were collected alive and placed directly into 80–95 % alcohol. Slide-mounting for specimen identification followed protocols of Martin (1987, 2004) with all permanent mounts made in Canada balsam. Line drawings were made using a compound microscope with camera lucida attachment. Composite micrographs were prepared by serial scanning with a Leitz Dialux compound microscope, the scanned sections electronically stacked and combined using AutoMontage® software, and the final images edited with Adobe Photoshop CS4®. Plates were prepared with other versions of Photoshop. SEM imaging by Ian Bedford was under-

taken using pupae attached to leaf material, rapidly frozen in slushed liquid nitrogen and immediately placed into the cold stage of the SEM, maintained at -180°C. Specimens were then sputter-coated with gold plasma, viewed and photographed with a CamScan Series 4 SEM.

Whitefly puparial descriptions generally follow the terminology of Martin (1987, 1999, 2004, 2005). Adult features are discussed in only a few cases where adults were reared from puparia, thus ensuring the true association of adults and their puparia. Some of the drawings reproduced here have previously appeared in other publications; where these are not the work of the present authors the original source is stated in the caption lines.

Holotypes of the new species are deposited in the BMNH and paratypes are distributed amongst BMNH, FERA, USNM and TFC-ENTOMO.

Quoted geographical distributions beyond the Canaries, and non-Canaries host plant records are generally attributable to Mound & Halsey (1978) and the BMNH collection. The nomenclature of all plant taxa follows The International Plant Name Index (http://www.ipni.org) and The Plant List (http://www.theplantlist.org). For angiosperm families, we follow Angiosperm Phylogeny Group III (2009) and for fern families, Smith *et al*. (2006). Determinations of the plant species were made by J. Alfredo Reyes-Betancort (Botany Unit, Instituto Canario de Investigaciones Agrarias). Family name and authority of each species are given in the index to the host plants (Appendix 2, p. 43).

Key to genera of Canary Islands whiteflies, puparia

1. Subdorsum with compound wax-producing pores, one cephalic pair and 4–6 abdominal pairs (Figs 39–41). Lingula large, tongue-shaped, extending beyond boundary of vasiform orifice, bearing 4 long setae. Each leg with an apical claw 11
- Without compound pores. Lingula bearing 0 or 2 setae only and usually accommodated within vasiform orifice. Each leg with an apical adhesion pad but without a claw. (Figs 4–9) 2

2. Dorsal disc with an array of elongate glandular "siphons" (Figs 34, 35) . . . . . *Siphoninus*
- Dorsal disc without siphons but sometimes dorsal setae are long and thickened (Figs 10, 25, 29) 3

3. Extreme outer submargin with a row of fine but distinct setae, normally 14 pairs including caudal pair (Fig. 33). Transverse moulting sutures reach puparial margin. Vasiform orifice triangular, posteriorly indistinct and lingula with a pair of basal lobes. . . . . *Parabemisia*
- Chaetotaxy different. Transverse moulting sutures not reaching puparial margin (Figs 30, 32, 38) 4

4 Operculum and lingula together occupy less than basal half of vasiform orifice whose floor is patterned with fine stippling; operculum much wider than long, and lingula minute (Fig. 2). Cuticle uniformly dark brown to black, and living puparia with a fringe of white wax but no visible dorsal wax (Fig. 43) . . . . . *Acaudaleyrodes*
- If operculum only occupies basal part of vasiform orifice then lingula always clearly visible and operculum and lingula together occupy more than half of orifice (Figs 8, 10, 28) 5

5 Submargin, and often also dorsal disc, with glandular papillae (Figs 36–38) that secrete filments of waxy material (Figs 83, 85); papillae in submargin usually almost contiguous but dorsal disc papillae variable in distribution. Lingula head distinctly lobulate, usually about as long as wide, at least partially exposed and always bearing an apical pair of setae. . . . . *Trialeurodes*
- Submargin without a row of contiguous papillae but dorsal disc may feature tubercles of varying forms (Figs 19–23). Lingula not lobulate (Figs 8, 10, 14) 6

6 Lingula mostly or entirely obscured by operculum which mostly or entirely occupies the vasiform orifice (Figs 3, 4, 32). . . . 7
- Lingula not obscured by operculum, and operculum only occupies basal part of vasiform orifice (Figs 6–30) 9

7 Thoracic and caudal tracheal openings at margin each marked by an invaginated "pore" (Fig. 32) . . . . . *Dialeurodes*
- Thoracic and caudal tracheal openings not differentiated from remainder of puparial margin (Figs. 3, 4) 8

8 Although approximately margin-concentric overall, submarginal / subdorsal fold arranged in distinct sections (Fig. 3); fold is complete between vasiform orifice and puparial margin. A distinct gland visible at base of each marginal crenulation. Living specimens covered by secreted waxy material (Figs 44, 45) . . . . . *Aleurothrixus*
- A narrower submargin defined by a smooth fold (Fig. 4) which is interrupted between vasiform orifice and puparial margin. Puparia evenly black and dorsum not covered by secretions (Fig. 42). . . . . *Aleurotrachelus*

9 Lingula either excluded beyond boundary of vasiform orifice or folded into the orifice such that only the tip protrudes (Fig. 5). If thoracic tracheal openings at margin are subtly differentiated as combs of teeth then the combs are slightly proud of main marginal outline (Fig. 5) . . . . . *Aleurotulus*

- Lingula fully included within vasiform orifice, with head exposed (Figs 6–30). If thoracic tracheal openings at margin subtly differentiated as combs of teeth then the margin is slightly emarginate at this point (Figs 13, 16, 26) 10

10 Abdominal segment VII not significantly reduced in length medially, with 8 subequal segments clearly visible between transverse moulting sutures and vasiform orifice (Fig. 6). Usually caudal furrow absent or little-marked. . . . . *Aleyrodes*
- Abdominal segment VII much reduced in length medially, abdomen sometimes appearing 7-segmented between transverse moulting sutures and vasiform orifice (Fig. 12, arrowed). Usually apex of vasiform orifice leads into a pronounced caudal furrow (Figs 12–30). . . . . *Bemisia*

11 Compound pores with anteriormost 2 abdominal pairs smaller than cephalic pair and posteriormost 4 abdominal pairs; submargin with 14 pairs of setae including caudal pair (Fig. 41). Adult female lays eggs within a "nest" of secreted woolly wax (Fig. 92) . . . . . *Paraleyrodes*
- Compound pores with cephalic pair similar in size to anteriormost 4 abdominal pairs; submargin with 12 pairs of setae including caudal pair (Figs 39, 40). Adult female lays eggs in a convoluted track of white mealy material, whilst wandering over leaf surface (Figs 86, 90, 91) . . . . . *Aleurodicus*

Subfamily ALEYRODINAE Westwood, 1840

DIAGNOSIS—puparia without dorsal compound pores; legs without claws but usually with adhesion pads; lingula much smaller than in Aleurodicinae and bearing 2 setae.

Genus *Acaudaleyrodes* Takahashi

Acaudaleyrodes Takahashi, 1951a: 382. Type species: *Acaudaleyrodes pauliani* Takahashi, 1951a by monotypy.

Comments. *Acaudaleyrodes* species are characterised by having black puparia with crenate or dentate margin, dorsal disc with a well developed rhachis and a pair of subdorsal longitudinal folds, vasiform orifice scutellate with a short operculum that, together with the lingula, occupies less than half of the orifice (Bink-Moenen & Gerling, 1990; Martin *et al*., 2000).

Acaudaleyrodes rachipora (Singh)

(Figures 2 and 43)

Aleurotrachelus rachipora Singh, 1931: 57–59.
Acaudaleyrodes rachipora (Singh) Russell, 1962: 64.
citri (Priesner & Hosny, 1934b: 7–8) (*Aleurotrachelus*) [Synonymised by Jesudasan & David, 1991: 242.]
alhagi (Priesner & Hosny, 1934b: 9) (*Aleurotrachelus*) [Synonymised with *citri* by Mound, 1965a: 119.]

Distribution in the Canary Islands: LANZAROTE: Costa Teguise, Órzola, Playa Blanca. FUERTEVENTURA: Toto. GRAN CANARIA: Las Palmas de Gran Canaria, Zárate, Mirador del Laso, Moya. TENERIFE: Agua Dulce, Barranco Badajoz, Barranco Moradas, Cuevas Negras, Las Américas, Playa San Juan, Valle Guerra. LA GOMERA: Barranco Santiago, San Sebastián. LA PALMA: Barranco de las Angustias, Los Cancajos, Los Sauces, Puerto Nao. **Elsewhere:** Palaeartic Region: widely distributed in Mediterranean countries, Crete, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Portugal, Rhodes, Saudi Arabia, Spain, Syria, Turkey; Ethiopian Region: widely distributed. Oriental Region: India, Pakistan.

Host plants in the Canary Islands: *Citrus reticulata*, *Euphorbia atropurpurea*, *Euphorbia balsamifera*, *Euphorbia berthelotii*, *Euphorbia lamarckii*, *Euphorbia regis-jubae*. **Other host plants listed**: Mound & Halsey (1978) listed plant species within 13 different plant families, including *Acacia spp.*, *Cassia spp.*, *Bauhinia sp.*, *Citrus sinensis*, *Psidium guajava, Punica granatum, Tamarindus indica*.

Comments: *A. rachipora* is a polyphagous species whose puparia are usually widely scattered under leaves. However, it sometimes occur in dense colonies on both surfaces of *Euphorbia* leaves in the Canary Islands. In the field,

it can be identified by the shiny black, rather convex, puparium, each individual surrounded by a narrow fringe of whitish waxy secretion (Fig. 43). Adults are also distinctive, with dark infuscation on the wings. The puparium is characterised in the generic heading above. *A. rachipora* has been mentioned as an important pest of *Citrus* in Egypt and Pakistan (Khan *et al*., 1991) and was considered by Llorens-Climent & Garrido-Vivas (1992) as a potential pest for Spanish citriculture. Martin (1987) also included this species in a guide to whitefly pests of the world, but to the authors' knowledge, *A. rachipora* has never caused significant damage to agricultural crops. In the Canary Islands, *A. rachipora* populations observed on *Citrus* have always been low, but very large numbers have been recorded on ornamental *Euphorbia* shrubs, even causing severe chlorosis and premature leaf-drop.

Genus *Aleurothrixus* Quaintance & Baker

Aleurothrixus Quaintance & Baker, 1914: 103. Type species: *Aleyrodes howardi* Quaintance, 1907, by original designation.
Aleurothrixus (*Philodamus*) Quaintance & Baker, 1917: 404. [Synonymised by Mound & Halsey, 1978: 61]
Hempelia Sampson & Drews, 1941: 166. [Synonymised by Martin, 2005: 20]

Comments. There are presently 17 described species accommodated within *Aleurothrixus* (Martin & Mound, 2007), generally of neotropical origin, with several undescribed species represented in the BMNH and USNM collections. Three Asian species originally described in *Aleurothrixus* were transferred to a new genus, *Asiothrixus*, by Dubey *et al*. (2010). *Aleurothrixus* comprises species characterised by the dorsal disc being almost completely separated from the submarginal area by a fold, the margin with coarse teeth each with a basal gland, and the vasiform orifice subcircular with lingular tip concealed (Fig. 3). Puparia of most species occur in groups under leaves, often secreting copious waxy "wool" (Fig. 44).

Aleurothrixus floccosus (Maskell)

(Figures 3, 44, 45)

Aleurodes floccosa Maskell, 1896: 432.
Aleurothrixus floccosus (Maskell) Quaintance & Baker, 1914: 103.
horridus (Hempel, 1899: 394) (*Aleyrodes*) [Synonymised by Quaintance & Baker, 1917: 403.]
howardi (Quaintance, 1907: 91) (*Aleyrodes*) [Synonymised by Costa Lima, 1942: 425.]

Distribution in the Canary Islands: LANZAROTE: Arrecife, Las Breñas, Playa Blanca, San Bartolomé, Tinajo. FUERTEVENTURA: Corralejo, Antigua, Pájara. GRAN CANARIA: Agaete, Arucas, La Aldea, Las Palmas de Gran Canaria, Marzagán, San Agustín, Santa Brígida, Santa Lucía, Telde, Valsequillo. TENERIFE: Bahía del Duque, Cuevas Negras, Güímar, Las Galletas, Los Cristianos, Los Realejos, Playa San Juan, Punta del Hidalgo, Puerto de la Cruz, Santa Cruz de Tenerife, Valle de San Lorenzo. EL HIERRO: Frontera. LA GOMERA: Barranco Santiago, Puerto Santiago, San Sebastián, Valle Gran Rey, Valle Hermoso. LA PALMA: El Paso, Santa Cruz de La Palma. **Elsewhere:** Neotropical Region: widely distributed; Neartic Region: Florida. Palaeartic Region: Mediterranean basin, Macaronesia, Japan; Ethiopian Region: widely distributed. Malagasian Region: Mauritius, La Réunion. Oriental Region: India. Austro-Oriental Region: Philippines, Singapore. Pacific Region: Galapagos Is., Tahiti.

Host plants in the Canary Islands: *Azadirachta indica, Citrus limon, Citrus maxima, Citrus sinensis, Coccoloba uvifera, Codiaeum variegatum, Melia azedarach, Passiflora edulis*. **Other host plants listed**: moderately polyphagous, including *Bougainvillea* sp., *Citrus nobilis*, *Mangifera indica*, *Psidium guajava*.

Comments: *Aleurothrixus floccosus,* commonly known as the "woolly whitefly", is an economically important pest of citrus. In the field, it can be easily distinguished by the finely tangled flocculent white wax obscuring the immature stages (Fig. 44, 45), and copious excretion of honeydew. The species is native to the neotropical region, and has been slowly extending its range for many years. In mainland Spain, *A. floccosus* was introduced into Málaga by 1968 and spread across all the citrus-growing areas in the country in just a few years (Llorens-Climent & Garrido-Vivas, 1992). The first record of this species in the Canary Islands was from 1966 (Anonymous, 1971);

however, material collected from the Canaries in 1937 is deposited at the BMNH. Currently, in the archipelago it is a relatively minor pest of *Citrus* and *Codiaeum variegatum*, an ornamental shrub, as the parasitoid *Cales noacki* (Howard) (Hymenoptera, Aphelinidae) is naturally controlling *A. floccosus* populations (Hernández-Suárez, 1999). Both pale-puparium and dark-puparium populations of *A. floccosus* have been observed in the Canary Islands, and elsewhere. This variation in puparial cuticular pigmentation between populations was mentioned by Quaintance & Baker (1917), Bink-Moenen (1983) and Martin (1999) and it suggests the possible existence of several races of this species.

Genus *Aleurotrachelus* Quaintance & Baker

Aleurotrachelus Quaintance & Baker, 1914: 103. Type species: *Aleurodes tracheifer* Quaintance, 1900, by original designation.
Luederwaldtiana Hempel, 1922b: 1185 [Synonymised by Martin, 2005: 22]

Comments. *Aleurotrachelus* is one of the largest genera of whitefly species with 74 species listed by Martin & Mound (2007).The type and many other species of the genus are neotropical. Species are generally characterised by having a dorsal disc defined by a pair of longitudinal cephalothoracic folds, the margin regularly toothed with glands at the tooth bases, a shallow rhachis and a subcircular vasiform orifice mostly occupied by the operculum.

Aleurotrachelus atratus Hempel

(Figures 4 and 42)

Aleurotrachelus atratus Hempel, 1922a: 3–4.

Distribution in the Canary Islands: TENERIFE: Punta del Hidalgo, Santa Cruz de Tenerife, Taganana. GRAN CANARIA: Las Palmas de Gran Canaria, Puerto de Mogán. LA GOMERA: San Sebastián. **Elsewhere:** Palaeartic Region (restricted to indoor plantings): England, France; Neotropical Region: Antigua, Bahamas, Barbados, Brazil, Colombia, Costa Rica, Dominica, Ecuador, Guadeloupe, Guatemala, Guyana, Mexico, Nevis, Puerto Rico, Saint Lucia, Trinidad & Tobago, Venezuela, Virgin Islands; Neartic Region: Bermuda, USA (Florida); Pacific Region: Hawaii, Samoa; Malagasian Region: Comoro Islands, La Réunion, Madagascar, Mauritius, Mayotte; Afrotropical Region: Cabo Verde, Mozambique, Sao Tomé, Saint Helena, Uganda.

Host plants in the Canary Islands: *Cocos nucifera*, *Codiaeum variegatum*, *Howea forsteriana, Syagrus romanzoffiana*. **Other host plants listed:** Borowiec *et al*. (2010) recently recorded this whitefly on 56 palm species (Arecaceae) although coconut palm seems to be its preferred host plant.

Comments: Originally described from *Cocos nucifera* L. in Brazil, in recent years this species has showed a rapid geographical dissemination (Borowiec *et al*., 2010). It reached the Canary Islands by 1998 (Hérnandez-Suárez *et al*., 2003). In the 1990s, it reached pest status in Puerto Rico (Medina *et al*., 1994) but only recently has been considered as a pest of significant economic status elsewhere (Borowiec *et al*., 2010). In the Canary Islands, it spread quickly from Tenerife to other islands. It is very common on coconut palms in gardens, but never in sufficiently large numbers for it to be considered an economically important pest in the archipelago. In the field, it can be recognised by its rather elongate black puparium surrounded by powdery white waxy material, each puparium with a prominent rhachis (Fig. 42). Exuviae of earlier instars often remain attached to the dorsum of the puparium.

Genus *Aleurotulus* Quaintance & Baker

Aleurotulus Quaintance & Baker, 1914: 101. Type species: *Aleurodes nephrolepidis* Quaintance, 1900, by original designation.

Comments. This genus currently comprises 6 species with the following characters: puparial margin regularly toothed (the teeth sometimes with glandular bases); vasiform orifice ovoid to cordate mostly occupied by opercu-

lum, with lingula often excluded beyond the orifice; submargin not differentiated from remainder of dorsal disc; abdomen with or without a rhachis depending on the species (Martin, 2005).

Aleurotulus nephrolepidis (Quaintance)

(Figures 5 and 80)

Aleurodes nephrolepidis Quaintance, 1900: 29–30.
Aleurotulus nephrolepidis (Quaintance) Quaintance & Baker, 1914:102.
extraniens (Bemis, 1904: 526) (*Aleurodes*) [Synonymised by Quaintance & Baker, 1914: 102.]
kewensis (Trehan, 1938:183 (*Aleuroplatus*) [Synonymised by Mound, 1966: 40.]

Distribution in the Canary Islands: TENERIFE: Puerto de la Cruz. **Elsewhere:** Palaeartic Region (restricted to indoor plantings in cooler areas): England, Hungary, Scotland, Spain; Malagasian Region: Madagascar; Neotropical Region: Brazil; Nearctic Region: USA (California, Pennsylvania).

Host plants in the Canary Islands: *Aspidium* sp., *Asplenium daucifolium*. **Other host plants listed**: Mound & Halsey (1978) listed 20 fern species within 7 different plant families, including: *Blechnum* spp., *Dryopteris* spp., *Polystichum* spp., *Nephrolepis* spp., *Pteris* spp. Martin & Camus (2001) listed the known hosts for this whitefly species.

Comments: *Aleurotulus nephrolepidis* is a specialist fern-feeder that was recorded in the Azores and Canary Islands by Martin *et al*. (2000: 448). On the Canary Islands *A. nephrolepidis* has been found only in Puerto de la Cruz Botanical Garden, and it is not of known economic importance. Gómez-Menor (1954) recorded "*Aleurotulus filicium* Goeldi" (a name combination not used elsewhere) from the same botanical garden, on the fern *Aspidium* sp., but this whitefly name was regarded as *nomen dubium* by Mound & Halsey (1978). However, Gomez-Menor's material (MHNM) was examined by the first author and confirmed to be *A. nephrolepidis*. In the field, it is extremely difficult to see because living nymphs are very cryptic and post-emergence pupal cases are translucent and widely scattered (Fig.80).

Genus *Aleyrodes* Latreille

Aleyrodes Latreille, 1796: 93. Type species: *Phalaena* (*Tinea*) *proletella* Linnaeus, 1758, by subsequent designation and monotypy.
Conantulus, Goux, 1988: 64 [Synonymised by Martin, 1999: 53.]

Comments. The genus *Aleyrodes* currently comprises 33 described species (Martin & Mound, 2007) with the following combination of characters: cuticle usually pale and smooth, sometimes dusky, showing little dorsal sculpturing; margin crenulated and not modified at thoracic tracheal areas; abdominal segment VII not reduced in length medially (Fig. 6); vasiform orifice rounded-triangular to cordate; lingula exposed but included within vasiform orifice; caudal furrow usually absent or little-marked (but see discussion of *A. bencomiae* sp. n.). *Aleyrodes* is regarded as the correct spelling of this genus but many species were described under *Aleurodes* and these are regarded as not having changed combination (Martin & Mound, 2007).

Aleyrodes proletella (Linnaeus)

(Figures 7, 46, 94)

Phalaena (*Tinea*) *proletella* Linnaeus, 1758: 537–538.
Aleyrodes proletella (Linnaeus); Latreille, 1801–1802: 264.
culiciformis (Geoffroy, 1785: 306) (*Phalaena*) [Synonymised with *A. chelidonii* Latreille by Latreille, 1807: 174.]
prenanthis (Schrank, 1801: 147) (*Coccus*) [Synonymised by Klimaszewski & Szelegiewicz, 1962:42.]
chelidonii Latreille, 1807: 174 [Synonymised by Walker, 1852:1092.]

brassicae Walker, 1852: 1092 [Synonymised by Haupt, 1935: 256.]
euphorbiae Löw, 1867: 746 [Synonymised by Zahradnik, 1991:113.]
youngi Hempel, 1901: 385 [Synonymised by Bondar, 1923: 125.]

Distribution in the Canary Islands: LANZAROTE: Arrecife, Costa Teguise, Femés, Tinajo. FUERTEVENTURA: Corralejo, Nuevo Horizonte, Vega del Río Palma. GRAN CANARIA: La Aldea, Las Palmas de Gran Canaria, Vecindario. TENERIFE: Agua Mansa, Agua Dulce, Altos de Güímar, Bajamar, Buenavista, Cuevas Negras, Icod el Alto, Las Galletas, La Guancha, La Laguna, La Matanza, La Orotava, La Perdoma, Lomo de la Medida, Los Realejos, Pajalillos, Puerto de la Cruz, Valle de Guerra. LA GOMERA: Barranco Santiago, Hermigua, San Sebastián, Vallehermoso. LA PALMA: El Paso, La Caldera, Los Llanos, Los Sauces, Los Tilos, Mirador de la Cumbrecita, Pico de las Nieves, Roque de los Muchachos. **Elsewhere:** Palaeartic Region: widely distributed in Europe and Mediterranean countries, Azores and Madeira; Ethiopian Region: Angola, Cabo Verde, Kenya, Mozambique, South Africa; Oriental Region: Taiwan; Australia: South Australia, Victoria; Pacific Region: New Zealand; Neotropical Region: Brazil; Neartic Region: eastern USA.

Host plants in the Canary Islands: *Brassica oleracea*, *B. oleracea var. italica, Ficus carica, Lactuca palmensis, Lactuca sativa, Lactuca serriola, Sonchus oleraceus, Sonchus* sp. **Other host plants listed**: hosts belonging to 12 plant families were listed by Mound & Halsey (1978) although this species shows a marked preference for Brassicaceae.

Comments: *Aleyrodes proletella* is noted as minor pest of brassicaceous plant species and is commonly known as the "European cabbage whitefly" (Martin *et al*., 2000). It is not known to be a vector of plant virus diseases. In the field, adults of *A. proletella* are easily distinguished by the diffuse brownish spots on the forewing (Fig. 94) and colonies of nymphs are frequently very numerous and covered by a fine white waxy powder (Fig. 46). Puparia are usually pale, in contrast with another species present in the archipelago, *Aleyrodes laurisilvae* sp. nov., whose puparia have a distinct dark patch in the median region—see below.

***Aleyrodes laurisilvae* Hernández-Suárez and Martin sp. n.**
(Figure 8 and 47)

PUPARIUM (Fig. 8). *Habitus*. The immature stages occur in dense colonies under leaves of the host plants and are covered by a fine, white waxy secretions. Cuticle is creamy with a longitudinal dark patch in median area. *Margin*. Outline broadly oval. 1.0 mm long, 0.7mm wide [n=10], generally widest at abdominal segment I. Margin crenate with thoracic tracheal pore areas not differentiated. *Dorsum*. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures almost reaching submarginal area. Submedian/subdorsal area of dorsal disc smooth; abdominal segmentation and meso-metathoracic division well marked and abdominal segment VII not significantly reduced in length medially. Vasiform orifice rounded-cordate, slightly elevated with inner margin lobate, inset from puparial margin by its own length; operculum laterally-rounded trapezoidal, occupying half of vasiform orifice, its posterior margin finely setose; lingula head rounded and expanded, exposed but not extending beyond posterior margin of vasiform orifice. Caudal furrow faintly defined. *Chaetotaxy.* Anterior and posterior marginal setae present and very short. Normal dorsal disc chaetotaxy comprises single submedian pairs of cephalic, eighth abdominal and first abdominal setae all of similar length, very short; eighth abdominal setae placed lateral to vasiform orifice; a pair of marginally-placed caudal setae present plus a row of fourteen tiny submarginal setae on each side of puparium. *Pores*. Simple pores of the geminate pore/porette type present in median area of abdominal segments and submargin, arranged in irregular rows; each porette at some distance from disc pore. *Venter.* Cuticle smooth, diaphanous. Ventral abdominal setae underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs. Middle and hind legs each with a tiny basal seta. Antennal bases anteromesad of fore legs and extending beyond prothoracic legs. Thoracic tracheal folds unpunctuated, but caudal tracheal fold faintly marked.

Material examined: Holotype puparium—TENERIFE: Barranco de las Moradas, near Icod de los Vinos [approx. 300–500m] 18.v.1997 (J.H. Martin #7052) on *Canarina canariensis* (Campanulaceae) (BMNH). **Paratypes:** 34

puparia, 7 third-instar nymphs, 1 second-instar nymph, 8 adults, same data as holotype; duplicate dry puparial and adult material on leaves, same data (BMNH); Las Mercedes, 7.vi.1997 (E. Hdez.) on *Canarina canariensis*; Güímar, 21.vii.1996 (E. Hdez.) on *Crambe strigosa* (Brassicaceae); Erjos, 6.iv.1997 (E. Hdez.) on *C. canariensis*; Cuevas Negras, 29.vi.1997 (E. Hdez.) on *C. canariensis*; Barranco Moradas, 18.v.1997 (E. Hdez.) on *C. canariensis*, same data but 6.iv.1997 (E. Hdez.) on *C. strigosa* and *C. canariensis*; Barranco de los Cochinos, 21.i.1995 (E. Hdez.) on *C. canariensis*; Barranco Badajoz, 25.i.1998 (E. Hdez.) on *C. canariensis*, same data but 11.i.1998 on *C. canariensis*, 1.xii.1996 on *C. canariensis*. LA GOMERA: San Sebastián, 15.vi.1997 (E. Hdez.) on *Tolpis sp.* (Asteraceae), LA PALMA: Los Tilos, 21.vi.1997 (E. Hdez.) on *Crambe santosi* and *C. canariensis* (BMNH, TFMC-ENTOMO, USNM).

Etymology: All the known host plants of this species are from the laurisilva vegetation zone, leading to our choice of name.

Comments: Originally misidentified as *A. singularis* Danzig (1964) by Martin and listed as such by Hernández-Suárez (1999), Hernández-Suárez & Oromí (2004) and Martin *et al*. (2000: 428, 448), this species is in fact only particularly similar to *A. singularis* in its habitus characteristics (see below). *Aleyrodes laurisilvae* is differentiated from *A. singularis* by the shorter dorsal setae and a less rounded vasiform orifice.

Material from the type series of *A. singularis* [Republic of Georgia, on *Euphorbia*], as well as material in BMNH from *Lactuca* spp. from other locations, has been studied: although with some variation, long hair-like dorsal setae are always present in *A. singularis* (Fig. 9).

In the field, puparia of *A. laurisilvae* have a dark infuscation in the median region of dorsum, and dense colonies develop under leaves and colonies of immature stages are covered by white waxy powder, this habitus appearance closely resembling that of *A. singularis* and leading to the earlier misidentification (Fig. 47).

Aleyrodes bencomiae **Hernández-Suárez and Martin sp. n.**
(Figures 10, 48–51**)**

PUPARIUM (Fig. 10). *Habitus*. The immature stages occur scattered under leaves of host plants. Cuticle is pale, often with four discreet dark spots, two between 1st and 2nd abdominal segments and two in the cephalothorax (Fig. 48). *Margin*. Outline elongate-oval, emarginated by leaf hairs so variably down-curved. 0.77mm long, 0.43mm wide [n=7], generally widest at abdominal segment I or II. *Dorsum*. Elevated from substrate and thus margin substantially deflexed especially behind vasiform orifice. Visible margin variably crenate, depending on degree of marginal deflexion; with thoracic tracheal areas not differentiated but with a distinct caudal "comb" of fine teeth. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures almost reaching submarginal area. Submedian/subdorsal area of dorsal disc smooth; abdominal segmentation and meso-metathoracic division well marked and abdominal segment VII not significantly reduced in length medially; submedian abdominal depressions not evident. Vasiform orifice (Fig. 49) subtriangular, a posterior tubercle present and inner margins of orifice lobed, orifice inset from puparial margin by its own length; operculum laterally-rounded trapezoidal, occupying half of vasiform orifice, its posterior margin finely setose; lingula head rounded, only slightly expanded, exposed. Caudal furrow present and caudal ridges well developed. *Chaetotaxy.* Anterior and posterior marginal setae apparently absent. Dorsal disc chaetotaxy comprises single submedian pairs of cephalic, eighth abdominal and first abdominal setae; eighth abdominal setae placed anterior to vasiform orifice; a pair of submarginally-placed caudal setae present plus a row of fifteen submarginal setae on each side. All dorsal setae similar in length, very long, thick and rather fleshy, each with a tubercular base. *Pores*. Simple pores of the geminate pore/porette type present arranged in two rows on median area of abdominal segments and scattered on subdorsum and submarginal areas; porette at some distance from disc pore. *Venter.* Cuticle smooth, diaphanous. Ventral abdominal setae underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs. Middle and hind legs each with a tiny basal seta. Antennal bases anterolateral to fore legs and extending outside prothoracic legs. Thoracic tracheal folds unpunctuated but caudal tracheal fold punctuated.

Material examined: Holotype puparium—TENERIFE: Barranco de Badajoz, Güímar, 25.i.1998 (E. Hernández-

Suárez coll.) on *Bencomia caudata* (Rosaceae) (BMNH). **Paratypes:** [all paratypes from same host] 9 puparia, 5 third-instar nymphs same data as holotype; same data as holotype but 1 third-instar nymph and 2 second-instar nymph 11.i.1998; 10 puparia, 7 third-instar nymphs and 4 adults, same date as holotype but 25.xi.2000 (Martin #7490); 30 puparia and 25 second and third-instar nymphs 25.i.1998; 28 puparia, 8 second-instar nymphs and 1 adult 11.i.1998 (E. Hdez.); 18 adults TENERIFE: Monte de las Mercedes, El Bailadero-Punta del Hidalgo road, 26.xi.2000 (Martin #7494); dry puparial material on leaves, Monte de las Mercedes, El Bailadero-Punta del Hidalgo road, 26.xi.2000 (Martin #7494) and Barranco de Badajoz, Güímar, 25.xi.2000 (Martin #7490) (BMNH, TFMC-ENTOMO, USNM).

Etymology: This species carries the name of its only known host, *Bencomia caudata*, on which it has been found several times. *Bencomia caudata* (Fam. *Rosaceae*) is a plant endemic to the Canary Islands that is known to occur in Gran Canaria, Tenerife and La Palma. It is present on rocky slopes and in open habitats in the evergreen laurel forest from 500 to 1500 metres.

Comments: This species is similar to *Aleyrodes elevatus* Silvestri (Fig. 11), a species which occurs on *Ficus carica* in the Mediterranean area and whose puparia also possess long dorsal setae. The major difference is in the greater length and thickness of dorsal setae in *A. bencomiae*, especially in the submarginal row. The characteristics of the puparia of *A. bencomiae* are not entirely typical for *Aleyrodes,* especially the pronounced caudal furrow and unusually thickened dorsal setae. However, the unreduced median length of abdominal segment VII, combined with short and rather cordate vasiform orifice, suggest that this is the most appropriate generic placement for this species. Female and male adult genitalia are shown in Figs 50 and 51.

Genus *Bemisia* Quaintance & Baker

Bemisia Quaintance & Baker, 1914: 99–100. Type species: *Aleurodes inconspicua* Quaintance, 1900: 28–29 [Synonymised with *Aleurodes tabaci* Gennadius, 1889: 1–3 by Russell, 1957: 122]
Roucasia Goux, 1940: 45 [Synonymised by Danzig, 1964: 326.]
Cortesiana Goux, 1988: 63 [Synonymised by Martin, 1999: 54.]
Lipaleyrodes Takahashi, 1962: 100 [Synonymised by Dubey *et al.* 2009: 541.]

Comments. This genus currently includes 49 species (Martin & Mound, 2007, updated by Dubey *et al*., 2009) whose puparia are characterised by having the vasiform orifice acute-triangular, usually leading into a pronounced caudal furrow, with abdominal segment VII reduced in length medially in relation to the more anterior segments (Fig. 12), and with the transverse moulting sutures terminating in the subdorsum. In the European–Macaronesian area, members of the genus *Bemisia* generally belong to either the *B. afer* or *B. tabaci* species complex. This is discussed in more detail under *B. afer*, below. We wish to make it clear that there are many taxa within *Bemisia sens. lat*., worldwide, that are demonstrably not members of either the *afer* or *tabaci* complexes, but these are outside the scope of this work.

Bemisia puparia may display pronounced phenotypic variation, with chaetotaxy and presence of dorsal sculpturing highly variable both between and within species as well as between species, often depending on the physical characteristics of leaf surfaces (Mound, 1963, 1965b). Whitefly puparia of several other genera are also notorious for displaying variation induced by physical characteristics of leaf surface, as discussed by Russell (1948) with reference to *Trialeurodes* species (see Fig. 38), and subsequently demonstrated experimentally by Mound (1963) with reference to *Bemisia tabaci* in Africa. There also appears to be variation in the production of dorsal waxes in various patterns in some *Bemisia* species or populations: this led to the separation of several species and their placement in the genus *Lipaleyrodes*, now regarded as a junior synonym of *Bemisia*.

However, some puparia of the *Bemisia afer* complex in the Macaronesian islands display extremes of variation that have not been seen anywhere else in the world, and it remains unknown whether some or all of these forms represent species, varieties, biotypes or simply extreme variations within species. Here, our approach to this phenomenon is to describe as new only two species whose puparia and adults are both very distinctive. However, we also discuss in detail and illustrate eight other puparial forms (A–H) that are particularly notable, and list their hosts.

Although there are no recorded species in the genera *Asterobemisia* and *Neobemisia* on the Canary Islands, this

group of species has puparia with very similar morphology to the *B. afer* complex. However, they have a longitudinal moulting suture that does not reach to the anterior margin, and the transverse moulting sutures curve anteriorly to meet at the anteriormost extremity of the longitudinal suture. David & Dubey (2009), from a study of material of *Asterochiton cordiae* David & Subramaniam and *Asterobemisia carpini* (Koch), along with the descriptions of *Bemisiella* species (Danzig, 1966) opined that the genera *Asterobemisia* Trehan and *Bemisiella* Danzig should be regarded as junior synonyms of *Bemisia* Quaintance & Baker. David & Dubey were sceptical about Danzig's description of glandular structures on the apices of the marginal crenulations. We have been able to examine two paratype puparia of *Asterobemisia mediorossica* Danzig & Gavrilov (2000), placed as a junior synonym of *Bemisiella artemisiae* Danzig (1966) by Danzig & Gavrilov (2002), and cannot see anything that resembles such "glands". We are thus in agreement with David & Dubey, that *Asterobemisia* and *Bemisiella* are congeners. However, we are also of the opinion that the characteristics of the transverse moulting sutures in *Asterobemisia* species, where the sutures curve anteriorly and actually join the longitudinal moulting suture (thereby leading to the complete loss of a heart-shaped section of dorsal cuticle when the adults emerge), are so fundamentally different from those seen in *Bemisia* puparia, that *Asterobemisia* should be retained as a valid genus. Several authors have stated that the degree of development of the subdorsal part of the anteriorly-curved transverse moulting suture in *Asterobemisia* is variable. We agree with this observation, but it is likely that this gradually develops into a true suture as adult emergence approaches—indeed, observations on a series of specimens lends weight to this hypothesis (Malumphy, personal observations). We conclude, therefore, that *Bemisiella* Danzig (1966) should become a junior synonym of *Asterobemisia* Trehan (1940) (**syn. nov**.) but that *Asterobemisia* should remain a valid genus (**stat. rev.**).

Bemisia afer* (Priesner & Hosny) *sens. lat.
(Figures 13, 14, 16, 17, 19–27, 57, 59, 60, 62–64, 66–71, 78–79)
[Many of these illustrations are referred to more specifically in the accounts of forms A–H, below.]

Dialeurodoides afer Priesner & Hosny, 1934b: 6.
Bemisia afer (Priesner & Hosny) Habib & Farag, 1970: 8–10.
hancocki Corbett, 1936: 20 [Synonymised by Bink-Moenen, 1983: 95.]
citricola Gómez-Menor, 1945: 293 [Synonymised with *hancocki* by Mound & Halsey, 1978: 114.]

Background. Generally, Canarian taxa belonging to *Bemisia sens lat*. may be assigned to either the *B. afer* complex or the *B. tabaci* complex. As currently understood, and was discussed by Gill & Brown (2010) and by Martin (2005), the *B. afer* complex displays the following puparial characters: vasiform orifice inset from the posterior margin of the puparium by at least its own length (often considerably more), the orifice having emarginate sides; presence of two submedian geminate pore/porette pairings on each side of abdominal segment I between the median line and the first abdominal setae (Fig. 31). In contrast, the *B. tabaci* complex can be distinguished by having the vasiform orifice straight-sided and inset from margin by less than its own length; only a single geminate pore/ porette pairing present mesad of the first abdominal seta on each side of abdominal segment I. Other characters that have been variously mentioned as useful to separate *afer* and *tabaci* complexes are the presence / absence of basal antennal spines, antennal position relative to fore legs, the proportion of the vasiform orifice length occupied by the operculum and the relative development of the caudal setae (Gamarra *et al*., 2010; Malumphy, 2004; Malumphy *et al*., 2009). However, controversy remains and some *Bemisia* puparia present in the Canary Islands are not easily placed within one or other of these two main groupings, a situation that also occasionally occurs with some west African populations, where puparia exhibit a mixture of both *afer* and *tabaci* characteristics (Malumphy, personal observations, FERA quarantine interceptions). Eight more extreme morphological forms are discussed in detail below, all belonging to the *B. afer* complex, but not representing all of the variation seen in this group in the Canaries. Although the Canarian *Bemisia* populations are mostly assignable to either the *afer* or the *tabaci* assemblages, worldwide there are many *Bemisia* species that do not appear to belong to either grouping.

Distribution of *B. afer sens lat.* in the Canary Islands: GRAN CANARIA: Barranco de Azuaje, Barranco de Larice near Moya, Cruz de Tejeda, Los Tiles, Pinar de Tamadaba. TENERIFE: Barranco de Badajoz, Barranco del

Agua, Barranco de los Cochinos, Barranco de las Moradas, Cuevas Negras, Erjos, Güímar, Las Mercedes, Punta del Hidalgo, Pico del Inglés, Valle Guerra. LA GOMERA: Chorros de Epina, El Cedro, Garajonay. LA PALMA: Los Tilos, Pista de Barlovento. **Elsewhere:** Palaeartic Region: Corsica, Egypt, England (Malumphy, 2003), France, Greece, Israel, Italy, Malta, Rhodes, Sicily, Spain, Turkey. Australia: Northern Territory, Queensland; Neotropical Region: Colombia and Perú.

Host plants of *B. afer sens lat.* in the Canary Islands: *Artemisia thuscula, Bencomia caudata, Bystropogon odoratissimus, Cistus monspeliensis, Cistus symphytifolius, Conyza bonariensis*, *Echium giganteum, Echium pininana, Echium* sp., *Echium virescens, Gesnouinia arborea, Laurus novocanariensis, Marcetella maderensis, Ocotea foetens, Persea indica, Phyllis nobla, Rubus bollei, Rubus* sp., *Rubus ulmifolius, Salix canariensis*, *Teline microphylla*, *Viburnum rigidum*. **Host plants listed from elsewhere:** Mound & Halsey (1978) recorded on 47 plant species belonging to 19 plant families, under the name *B. hancocki*, a list that was considerably augmented by Bink-Moenen (1983). The *B. afer* complex as a whole is highly polyphagous.

Comments: *Bemisia afer sens. lat.* appears to be an assemblage of taxa with a particularly broad range of puparial forms (Gill and Brown, 2010). Most notable variations are the lengths of dorsal setae (from minute to nearly half as long as the width of the puparia or more) and the differing sizes, shapes and placements of dorsal elevations and protuberances (differing from granular elevations to star-shaped tubercles). These variable morphological characteristics are affected, at least in part, by host plant morphology, including presence or absence of leaf hairs, and differences in the morphology of the upper and lower leaf surfaces that affect the morphology of the puparia. Differing characteristics of whitefly puparia from the the upper and lower leaf surfaces may result in wide variation of puparia on a single plant (Bink-Moenen, 1983, 1992). Such differences between puparia from upper and lower surfaces of leaves have also been repeatedly observed in the Canarian material of *Bemisia afer* complex (Figs 13, 15, 25, 26). Characters that can change between upper and lower surface morphs include presence or absence of tracheal combs and tracheal fold stippling (which is only observed in the very smooth and flat specimens on the upper surface), length of dorsal setae (rather than the number of them) and presence and relative development of tubercles and cuticular sculpturing. Unfortunately, unless field appearance is noted at the time of collecting, it is usually impossible to tell whether unique wax patterns may have existed in life, because these waxes would have been removed in the slide-making process. These, and other problems arise when attempting to determine species limits within the *B. afer* complex.

It has been shown experimentally that *Bemisia tabaci* puparia can vary considerably when developing on different hosts (Mound, 1963). However, several nominal species of *Bemisia* were placed in synonymy with *B. tabaci* by Russell (1957) before Mound's experimental results were published. Neal & Bentz (1999) demonstrated that the development of dorsal structures such as setae, tubercles and papillae in the puparial stage depends on the tactile experiences of the first instar. Prior to our studies in the Canary Islands, it was generally thought that such puparial variation was more extreme in the *tabaci* complex than in the *afer* complex. However, intensive field sampling on native macaronesian plants, not only in the Canaries but also in Madeira and the Azores, has revealed more extreme morphological variation within the *afer* complex than seen in the *tabaci* complex.

It is believed that the *Bemisia afer* complex may have originated in Africa but it is now much more widely distributed (Mound, 1965a). Mound was referring to *B. hancocki* Corbett, which is currently placed as a synonym of *B. afer,* although Martin (1987: 307) discussed characteristics which may lead to a reappraisal of this synonymy. Martin (1999) designated a lectotype for *B. hancocki*. The mooted origin in Africa may well be correct for the apparently endemic forms on the Macaronesian Islands, but this is probably too simple a theory when worldwide populations of the *afer* complex are considered. There are some morphological differences, of unknown significance, amongst populations of the *afer* complex worldwide, such as differing puparial lingular shape and moulting suture morphology. If populations of either *tabaci* or *afer* were moved across the globe by man alone, it is unlikely that these differences could have evolved in such a very short period of evolutionary time. From an evolutionary standpoint then, the current distribution of whiteflies across the globe, as well as some fossil evidence, suggest that whitefly morphology and species delimitation were well developed between 140 and 80 million years ago, suggesting that many present day genera and species were probably extant before the breakup of the Laurasian and Gondwanan landmasses. It is extremely likely that populations moved with the landmasses and have been isolated for

millions of years prior to movement of whiteflies and other living organisms by man, starting around the 14th century. Nevertheless, movement by man has seriously clouded the picture, as indicated by the movement of the "B" biotype of *B. tabaci* around the world starting in the early 1980s.

With the recent development of molecular technologies, it is now possible to find non-morphological differences between populations, which should eventually lead us to a better understanding of evolutionary history, phylogenies and species limits with in the Aleyrodidae. Hopefully, molecular expression within populations will not be influenced by the widely variable morphologies that occur, so that we will have a better understanding of the limits of that variability, and thus be able to more accurately define species.

Similar puparial morphs of the *afer* complex have been observed on different host plants and, conversely, widely differing morphs have been found on very similar host plants, across the northern islands of Macaronesia. For example, *Bemisia lauracea* Martin *et al*. (1996) is a member of the *B*. *afer* complex associated with the laurel forest in Madeira. It was described from *Ocotea foetens*, *Laurus azorica* and *Persea indica*. *Bemisia lauracea* can be recognized by the characteristic delineation of the submedian area of the puparium, which is also covered by a thick layer of glassy wax secretion in life. In addition to *B. lauracea,* several other forms of the *B. afer* complex have also been discovered on the same lauraceous hosts in both Madeira and the Azores, as well as in the Canary Islands.

We have considered it prudent not to describe all of the Canarian forms as new species, since to do so would require a much more extensive comparative study of populations from a wider area than that considered in this work. However, we have decided to name two of the Canary Islands forms of the *Bemisia afer* complex as new species, based on supporting adult morphology in one, and highly unusual wax secretions in the other. However, we feel that it is of considerable interest to discuss in detail, and illustrate here, eight of the other Canary Islands forms which we term A to H, without making premature judgements on whether these represent species, subspecies, forms, biotypes or varieties.

The following eight examples of variation within what appears to be the *afer* complex indicate the intricacy of the situation within the complex on the Canary Islands, and a similar situation exists in Madeira and the Azores. The general morphology of each Canarian "form" seems consistent with the parameters set forth for *B. afer* by Bink-Moenen (1983) which describe the open, narrow vasiform orifice, operculum not covering entire orifice, and elongate lingula with one pair of subapical setae, reduced seventh abdominal segment at the midline, as well as variable lengths of dorsal setae and protuberances in some individuals. Each form also displays four pore/porette geminate pairs on the first abdominal area between the abdominal setae, two pairs on either side of the median line (as in Fig. 31). Specimens of the *afer*- complex usually have very short caudal setae as compared to specimens in the *tabaci* complex. However, many of these Canary Island forms have caudal setae greatly elongated if other dorsal setae are also elongated. Most of these forms do not show the formation of extraordinary visible dorsal waxes but the very ornate appearance of form G puparia suggests that secretions are produced by the tuberculate dorsal protuberances. Since the tentacle-like projections on living and unprocessed specimens (Fig. 70) do not appear the same as they do on slide-mounted individuals (Fig 22) they therefore must be waxen extrusions. Differences amongst the eight undescribed forms and the other named *afer*-complex species in the Canary Islands are found in the dorsal setal lengths, numbers of discernable setae and their locations (particularly on the submargin and cephalic areas), the shapes and placement of the dorsal protuberances, and the production of visible waxen ornamentations. Upper and lower leaf-surface puparial morphologies on the same plant further complicates the situation.

***Bemisia afer sens lat.* form A**
(Figure 14)

PUPARIUM. *Habitus*. The immature stages occur scattered on the lower surfaces of leaves of the host plants, not secreting visible dorsal wax. Cuticle is pale making it difficult to see it in the field. *Margin*. Outline broadly oval, 1.07 mm long, 0.85 mm wide, generally widest at abdominal segment I; margin crenate with thoracic tracheal openings unmarked. Anterior and posterior marginal setae present, longer than dorsal setae. *Dorsum*. Submedian/subdorsal area of dorsal disc smooth, only with a reticulate impression (Fig.14). Submedian abdominal depressions particularly well marked, especially in the anterior segments (similar to *B. medinae*, Fig. 18). *Chaetotaxy.* Eight

pairs of abdominal, and six pairs of cephalothpracic setae present, all minute, microseta-like, as in figure. *Venter*. Thoracic tracheal folds spiculate, distinct.

Material examined: GRAN CANARIA: Jardín Botánico Canario Viera y Clavijo on *Marcetella maderensis* and *Bystropogon odoratissimus* (both introduced).

***Bemisia afer sens lat.* form B**
Figures 16, 17, 60

PUPARIUM. *Habitus*. The immature stages occur scattered under leaves of the host plants, without visible waxy secretions (Fig. 60). Cuticle is pale. *Margin*. Outline boadly oval, 1.2mm long, 0.84mm wide, generally widest at abdominal segment I. Margin undulate with thoracic tracheal combs present. Has nearly the same attributes as *afer sens. lat*. *Chaetotaxy.* Eight abdominal pairs and seven cephalothoracic dorsal pairs. Two lengths of setae occur, one type (from *Ocotea*) has submarginal setae much elongated (Fig. 16), except for the eighth abdominal pair and two anterior submarginal pairs which are minute. A variant, on *Laurus, Viburnum* and *Persea*, has short submarginal setae that are nearly the same length as all other body setae (Fig. 17). Typical of *afer sens*. *lat*., and nearly identical to *B. medinae* except for the lack of a color pattern. *Venter.* Thoracic tracheal folds faintly marked, as shown (Fig. 16).

Material examined: GRAN CANARIA: Los Tiles on *Ocotea foetens*. TENERIFE: Las Mercedes, Güímar, Erjos, Barranco de las Moradas on *Laurus novocanariensis*, *Viburnum rigidum, Ocotea foetens* and *Persea indica*. LA GOMERA: El Cedro on *Laurus novocanariensis* and *Viburnum rigidum.*

***Bemisia afer sens lat.* form C**
(Figures 19, 20, 59, 64, 69)

PUPARIUM. *Habitus*. The immature stages occur scattered under leaves of host plants, amongst the leaf hairs (Fig. 59), without visible waxy secretions. Cuticle pale. *Margin*. Outline ovoid, 0.72mm long, 0.49mm wide, generally widest at metathorax. Margin undulate, with thoracic tracheal openings not marked, and deeply and irregularly emarginated because of leaf hairs. Most specimens somewhat elongated as compared to *afer sens. lat*., probably due to the many closely arranged leaf hairs of the host. This form is characterized by elongated dorsal setae and protuberances composed of multiple lobulate tubercles along the midline and the subdorsal arc (Figs 64, 69). Specimens from *Cistus* tend to have fewer and smaller protuberances than those specimens from *Echium* (Fig. 64). *Chaetotaxy.* Variable, with nine pairs of abdominal and from six to nine cephalothoracic pairs, most hair-like and very long (0.1mm).

Material examined: TENERIFE: Valle Guerra, Erjos, Barranco de las Moradas, Barranco Badajoz on *Echium virescens*, *Cistus sp.* LA GOMERA: El Cedro on *Echium giganteum*, *Echium virescens*; Garajonay on *Cistus* sp. LA PALMA: Los Tilos on *Echium pininana*. GRAN CANARIA: Pinar de Tamadaba on *Cistus ochreatus*.

***Bemisia afer sens lat.* form D**
(Figures 21, 23)

PUPARIUM. *Habitus*. The immature stages occur scattered on lower surfaces of leaves of host plants, without visible waxy secretions. Cuticle pale. *Margin*. Outline ovoid, 0.75mm long, 0.55mm wide, generally widest at metathorax. Margin undulate with thoracic tracheal openings not marked. In this form the multiple dorsal tubercles are much smoother than in form C, not lobulate. *Chaetotaxy.* All setae are hair-like and very long (0.1mm), as shown in Fig. 21.

Material examined: TENERIFE: Erjos, Barranco de las Moradas near Icod de los Vinos, Barranco de los Cochinos on *Gesnouinia arborea, Phyllis nobla*. LA GOMERA: El Cedro, Chorros de Epina on *G. arborea.* GRAN CANARIA: Barranco de Azuaje on *Salix canariensis*.

***Bemisia afer sens lat.* form E**
(Figure 24)

PUPARIUM. *Habitus*. The immature stages occur scattered on lower surfaces of leaves, without visible waxy secretions. Cuticle is pale. *Margin*. Outline ovoid, 1.0mm long, 0.6mm wide, widest at metathorax. Margin crenulate with thoracic tracheal openings not marked. Characterized by short dorsal setae and multiple large lobulate protuberances along the midline and subdorsal arc. Numerous small dome-like simple protuberances scattered across the submarginal areas are present. *Chaetotaxy.* Apart from the cephalic, first and eighth abdominal and caudal setal pairs (which are themselves very small) dorsal setae are apparently not present, but anterior and posterior marginal setal pairs are present.

Material examined: GRAN CANARIA: Cruz de Tejeda on *Teline microphylla*.

***Bemisia afer sens lat.* form F**
(Figures 25, 26, 63, 68, 71, 78, 79)

PUPARIUM. *Habitus*. The immature stages occur scattered or aggregated on both surfaces of leaves of host plants, without visible secreted dorsal wax (Fig. 63). Cuticle is pale. *Margin*. Outline oval, generally widest at abdominal segment I. In forms from the lower leaf surface margin undulate with thoracic tracheal openings not marked (Fig. 25), but the overall outline often heavily emarginated by leaf hairs. In specimens from upper surfaces of leaves (Fig. 26), tracheal openings marked as thickened crenulations and puparial outline smooth. Thus, two morphologies occur within the populations on this host. In upper-surface specimens small dome-like protuberances present on the abdominal midline, and reduced numbers of protuberances along the subdorsal arc (Fig. 26). Lower leaf-surface specimens (Fig. 25) have large multilobed protuberances on dorsal midline and subdorsal arc, the protuberances being extremely lobulate, the lobulate tubercles visible in both living and preserved specimens. *Chaetotaxy.* Nine pairs of abdominal and nine pairs of cepalothoracic setae present, most long and stout (including eighth abdominal and caudal pairs) but a few cephalothoracic pairs minute; posterior marginal setae exceptionally long, resembling long dorsal setae. *Venter*. Thoracic tracheal folds faintly marked in upper-surface puparia.

Material examined: TENERIFE: Las Mercedes, Valle Guerra, Barranco Badajoz on *Bencomia caudata*.

***Bemisia afer sens lat.* form G**
(Figures 22, 62, 66, 70)

PUPARIUM. *Habitus*. The immature stages occur scattered on lower surfaces of leaves of host plants, without visible waxy secretions (Fig. 62). Cuticle pale. *Margin*. Outline ovoid, generally widest at metathorax. Margin undulate with thoracic tracheal openings not marked but puparial outline deeply emarginated because of leaf hairs. The dorsal protuberances appear star-like on slide mounted specimens (Fig. 22), but often with very elongated finger-like extensions of varying lengths visible on living and unprocessed specimens (Figs 66, 70), which apparently are wax extensions emanating from shorter tubercles. Submarginal area with small dome-like protuberances similar to those seen in form E. *Chaetotaxy.* With eight pairs of abdominal and four pairs of cephalothoracic setae, including the nominal cephalic, first-abdominal, eighth-abdominal and caudal pairs, of varying lengths but all stout and clearly visible. [There may be a few additional minute cephalothoracic setae present but extremely difficult to resolve.]

Material examined: TENERIFE: Las Mercedes, Güímar, Barranco de las Moradas, Barranco del Agua, Barranco de los Cochinos, Barranco Badajoz on *Rubus ulmifolius* and *Rubus bollei*. LA PALMA: Pista de Barlovento on *Rubus bollei.* GRAN CANARIA: Barranco de Larice near Moya on *Rubus sp.*

***Bemisia afer sens lat.* form H**
(Figures 27, 57, 67)

PUPARIUM. *Habitus*. The immature stages occur scattered or aggregated on both sides of leaves of the host plants, with waxy secretions in the form of dense, very fine, rather spatulate filaments (Fig. 67). Cuticle pale with four dark infuscated areas; lingula and operculum also characteristically pigmented (Fig. 57). *Margin*. Outline ovoid, generally widest at metathorax. Margin undulate with thoracic tracheal openings not marked. *Chaetotaxy*. Specimens of form H have seven pairs of cephalothoracic setae and nine pairs of abdominal setae (including the cephalic, first abdominal, eighth abdominal and caudal pairs) as shown in Fig. 27, all rather fine and needle-like; anterior and posterior marginal setae present, similar to dorsal setae.

Material examined: TENERIFE: Barranco Badajoz, Cuevas Negras, Güímar, Punta del Hidalgo, Valle Guerra on *Artemisia thuscula.* GRAN CANARIA: Los Tiles on *Artemisia thuscula*.

***Bemisia euphorbiarum* Hernández-Suárez and Malumphy sp. nov.**
(Figures 15, 31, 52–55, 76–77)

PUPARIUM (Figs 15, 54, 55). *Habitus*. Most frequently observed feeding on the lower surfaces of the foliage but puparia are also common on the upper leaf surfaces and occasionally on the stems. Usually with a thick dorsal layer of wax when developing on the upper surfaces, lending a greyish appearance. Cuticle is generally pale, but upper-surface individuals often have distinctly brownish pigmentation. *Margin*. Outline oval to elongate-oval, 1.25 mm long, 0.84 mm wide [n=11], generally widest at abdominal segment I. Margin finely crenulate, about 12 shallow teeth per 0.1mm with thoracic tracheal areas not differentiated. *Dorsum*. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures nearly reaching submarginal area. Submedian area of dorsal disc smoother than submargin but may be defined by a line of tubercules which are much more obvious in upper surface specimens (Fig. 15, left); abdominal segmentation and meso-metathoracic division well marked and abdominal segment VII significantly reduced in length medially such that only seven segments are discernible along median line; submedian abdominal depressions little marked. Vasiform orifice acuminate-triangular, inset from puparial margin by its own length, and leading into a very narrow caudal furrow bounded by caudal ridges that are well defined; operculum cordate, occupying less than half length of vasiform orifice, finely setose; lingula head exposed, slender elongate, apically acute, a stout setae on each side of apical point, but lingula entirely accommodated within vasiform orifice; vasiform orifice floor with inner ridges (Fig. 15). *Chaetotaxy.* Anterior and posterior marginal setae present, hair-like, only slightly shorter than caudal setae. Normal dorsal disc chaetotaxy comprises single submedian pairs of cephalic, eighth abdominal and first abdominal setae, all minute; eighth abdominal setae placed lateral to anterior edge of vasiform orifice; a pair of marginally-placed caudal setae present, which are the longest of all the setae, plus a row of twelve minute submarginal setae on each side. *Pores*. Simple pores of the geminate pore/porette type present; four rows of simple pores in submarginal and submedian areas; two pairs of the geminate pore/porette type on each side of abdominal segments, including two pairs on each side of abdominal segment I between first abdominal setae (Fig. 31). *Venter.* Cuticle smooth, diaphanous. Ventral abdominal setae underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs. Middle and hind legs each with two tiny basal setae, the antennae usually overlain by fore legs. Antennal bases anteromesad to fore legs. Tracheal folds lightly stippled.

OVUM (Fig. 52). *Habitus*. Elliptical, broadly rounded at the base and narrow apically. Cream coloured when first laid, becoming dark brown to almost black. Red eyes and yellow mycetome bodies of the first instar just visible prior to hatching. Eggs are scattered, laid singularly or in small groups, usually on the lower surface but also fre-

quent on the upper surface of the foliage, and less frequently on the stems. The chorion is smooth and shiny with little wax evident. Each egg is erect and firmly attached to the leaf surface by a slender, short peduncle extending from the base of the egg, inserted into the plant tissue. After hatching, the egg remains upright and is a dark golden brown colour. Length 204 microns (200–208 microns), width 86 microns (78–96 microns), 2.39 (2.17–2.62) times longer than wide. Peduncle length 40 microns and width 12 microns.

FIRST-INSTAR LARVA. Ha*bitus*. Scale-like, pale translucent yellow, becoming dark grey as they mature. Reddish eye spots and two yellow abdominal mycetomes are just visible. A narrow band of white wax is present around the margin. *Margin*. Outline ovoid, lozenge-shaped; length 291 microns (276–310 microns) and width 192 microns (182–202 microns), 1.51 (1.42–1.57) times longer than wide. With 16 pairs of well-developed setae: Caudal setae (CS) length 63 microns (58–69 microns); Marginal setae (MS) 14 pair length 69 microns (64–76 microns); ratio CS/MS14 = 0.91 (0.83–1.01). Margin evenly, faintly crenulate. *Dorsum*. Some slide-mounted specimens are brown in colour. Chaetotaxy comprises paired anterior submarginal seta length 29 microns (26–31 microns); cephalic seta length 3 microns (3–4 microns); first abdominal seta length 3 microns (2–4 microns); eighth abdominal seta length 4 microns (3–5 microns). Cephalic tubercles usually weakly developed, oval. Vasiform orifice almost quadrate and closed behind, length 30 microns (28–32 microns). Lingula head spinulose with two pairs of stout setae, half-covered by the operculum. Operculum and lingula pigmented light brown. *Venter*. Legs well developed. Fore coxae with short spine, mid and hind coxae with long setae and short spines. Tibia-tarsi distinctly spinose. Antennae long and slender, length 81 microns (77–85 microns). Abdominal setae almost parallel to anterior margin of vasiform orifice or displaced slightly behind. Cuticle fine, diaphanous.

ADULT (Figs 53, 76, 77). *Habitus*. Head and antennae grey; thorax grey with scutellum greyish-yellow; legs grey; abdomen yellowish with grey base, genitalia and dorsum with paired transverse grey bands; wings covered with sparse, grey powdery wax. The greyish appearance described above is due to waxy secretions, and the true body colour and sclerotic patterning are shown in Figs 76 & 77. Head and thorax, base of abdomen, areas of the tergites, male collar and female gonapophysis and supragenital plate, legs and antennae, all strongly pigmented brown; wings hyaline. Antennae 7-segmented. Antennal segment II about half as long as antennal segment III; antennal segment III about as long as segments IV–VII combined; segments V–VII subequal, segment IV much shorter. Segment II with long, slender, conical sensorium which may be difficult to distinguish from the enlarged setae. Segment III with one sensorium located on the proximal portion, and three sensoria (a cone and two rhinarial-types) on the distal portion. The cone is approximately a quarter of the segment length away from the apex. Segment IV without a sensorium; segment V with a distal rhinarial-type sensorium; segment VI with a subapical sensorial cone, and segment VII with both a sensorial cone and an adjacent rhinarial sensorium, arising near the middle of the segment and the segment terminating in a narrow conical sensorium. Upper eye composed of 60–67 ommatidia, each 10 microns in diameter; lower compound eye composed of 41–42 ommatidia, each 12 microns in diameter, arranged in interconnected groups of 6 pigmented ommatidia surrounding a clear, smaller ommatidium. Upper and lower eyes separated by a space equal to or slightly less than the width of an ommatidium. Metatibial combs consisting of 21–24 setae, mesotibial brushes consisting of 3–4 adjacent setae. Male claspers paired, with about 10 long setae. Aedeagus ventral base smooth; distal portion curved upwards, tapering and pointed. Female cement gland is sinuous, without bands and with a small head.

Etymology: This whitefly species colonises several different *Euphorbia* species, belonging to the subsection. *Pachycladae*, comprising *E. regis-jubae*, *E. lambii, E. lamarckii, E. balsamifera* and *E. atropurpurea*; thus *B. euphorbiarum* is considered an appropriate name.

Material examined: Holotype puparium—GRAN CANARIA, Las Palmas de Gran Canaria, Zárate, 04.i.2001 (C. Malumphy coll. CM2001–4) on *Euphorbia balsamifera* or *E. regis-jubae* (BMNH). **Paratypes:** 25 puparia, 6 third instars, 7 first instars, 10 adults, same data as holotype (FERA); 2 puparia, same data as holotype but (#CM92-010) on *E. balsamifera*, 31.iii.1992, with *Acaudaleyrodes rachipora* (FERA); 10 puparia, 4 eggs, same data as holotype but (CM11-393) on *E. regis-jubae*, 8.i.2011, duplicate material stored in ethanol (FERA); 8 puparia, 1 adult and 9 second and third-instars nymphs, TENERIFE, Barranco near Punta del Hidalgo, 28.xi.2000 (Martin #7495) on *E. lamarckii* var. *wildpretii*; 9 puparia TENERIFE, Barranco de las Moradas, near Icod de los Vinos [approx. 300–

500m] 18.v.1997 (Martin #7051) on *E. lamarckii* var. *wildpretii*; 6puparia and 1 first-instar nymph TENERIFE, Bajamar, 26.xi.2000 (Martin #7492) on *E. lamarckii* var. *wildpretii*; 17 puparia TENERIFE, Valle de Guerra [Govt.Agric.Labs] 20.v.1997 (Martin #7057) on *E. lambii* (BMNH, TFMC-ENTOMO, MNCN, USNM). **Other material examined:** LANZAROTE: Playa Blanca, 30.xii.1997 (E. Hdez.) on *E. regis-jubae*, same data but: 29.xii.1996 on *E. balsamifera*; Costa Teguise, 9.iii.1997 (E. Hdez.) on *E. balsamifera*, same data but 8.iii.1997 (E. Hdez.) on *E. balsamifera;* GRAN CANARIA: Moya, 22.i.1998 (E. Hdez.) on *E. regis-jubae*, *E. balsamifera*; Barranco Azuaje, 22.i.1998 (E. Hdez.) on *E. regis-jubae*. TENERIFE: Valle Guerra, 12.vi.97 (E. Hdez.) on *E. atropurpurea*, same data but 22.v.1997 on *E. atropurpurea*, 20.v.1997 on *E. lamarckii* var. *wildpretii*; Erjos, 6.iv.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Cuevas Negras, 29.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Barranco del Agua, 11.i.98 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Barranco de las Moradas, 6.iv.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*, same data but 18.v.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; LA GOMERA: San Sebastián, 14.vi.1997 (E. Hdez.) on *E. berthelotii*; Hermigua, 15.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Barranco Santiago, 24.i.1998 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; LA PALMA: Puerto Nao, 22.vi.1997 (E. Hdez.) on *E. balsamifera*; Los Sauces, 21.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Los Cancajos, 21.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Road Tazacorte, 22.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Barranco de las Angustias, 22.vi.1997 (E. Hdez.) on *E. lamarckii* var. *wildpretii*.

Material was also observed in the field in LA GOMERA (road San Sebastián) and EL HIERRO (Sabinosa) but vouchers were not collected.

Comments: The puparia of *B. euphorbiarum* are morphologically similar to *B. afer sens. lat.* but may be distinguished using the following suite of characters: cuticle generally pale, or with diffuse brownish pigmentation, but without a regular pigmented pattern; dorsal submedian abdominal depressions indistinct and all dorsal setae minute; dorsum with a row of normally 12 minute setae on each side, located in the submarginal area, and without lobulate protuberances. In life, puparia are covered with a thick dorsal layer of translucent wax. The adults of *B. euphorbiarum* are distinctive and easily distinguished from those of *B. afer sens. lat*. The head and thorax of *B. euphorbiarum* are pigmented dark brown (appearing grey in life due to a coating of wax), whereas the head and thorax of *B. afer sens. lat*. are unpigmented. *Bemisia euphorbiarum* is the only *Bemisia* species that feeds on *Euphorbia* subsection *Pachycladae*.

Although not considered a major pest in the Canary Islands this whitefly can achieve high populations that produce leaf distortion, curling chlorosis and premature leaf-drop of ornamental *Euphorbia* shrubs. Most puparia cause a chlorotoic spot on the leaf surface opposite the feeding surface. *B. euphorbiarum* may occur on the same leaves as puparia of *Acaudaleyrodes rachipora*. The occurrence of puparia of *B. euphorbiarum* on both surfaces of leaves is unusual but certainly not unique: for example, puparia of *B. afer complex* on *Laurus nobilis* in England occasionally develop on the upper surfaces of leaves (C. Malumphy, personal observations).

The holotype has been selected because this particular puparium still contains the head and thorax of the pharate adult and clearly displays separated upper and lower eyes. However, adults collected on *Euphorbia*, that appear to be *B. euphorbiarum*, also exhibit upper and lower eyes conjoined by one ommatidium, a situation also noted by Malumphy *et al.* (2009). Molecular research aligns *B. euphorbiarum* populations with New World *Bemisia afer* complex (Gill & Brown, 2010).

Euphorbia regis-jubae, apparently the preferred host for *B. euphorbiarum*, is distributed in the eastern Canary Islands (Lanzarote, Fuerteventura and Gran Canaria) and in south-western Morocco, on cliffs, rocky slopes and disturbed areas. *E. lamarckii* is a western Canarian endemic species; two varieties (var. *lamarckii* in the south an west, and var. *wildpretii* in the north) occur in Tenerife, and only one variety (var. *wildpretii*) occurs in La Gomera, La Palma and El Hierro. *E. atropurpurea* is endemic to the south and west of Tenerife Island where it is exposed to humid winds on cliffs, whilst *E. berthelotii* is endemic to the south and west of La Gomera. *E. balsamifera* Ait. is present on all of the Canary Islands, mainly in the lower-altitude regions near the coast, but also grows in North Africa.

***Bemisia medinae* Gómez-Menor**
(Figures 18, 61, 65, 72, 73)

Bemisia (*Roucasia*) *medinae* Gómez-Menor, 1954: 369.
Bemisia medinae (Gómez-Menor) Danzig, 1964: 326.

Distribution in the Canary Islands: TENERIFE: Barranco del Agua, Barranco Badajoz, Barranco de los Cochinos, Barranco de las Moradas, Erjos, Las Mercedes. LA GOMERA: El Cedro. **Elsewhere:** known only from the Canarian archipelago.

Host plants in the Canary Islands: *Ageratina adenophora, Hypericum canariense* and *Hypericum grandifolium*.

Comments: This species clearly belongs to the *Bemisia afer complex*. The puparia possess a distinctive pigmentation pattern (Fig. 61) that Gómez-Menor regarded as an important character. Also, in contrast to other *Bemisia afer*-group morphs that are usually scattered widely, *B. medinae* usually occurs in crowded colonies under leaves of the host plant. If it had not already been formally described by Gómez-Menor we would have treated this as another morphological form of *B. afer* here. Male and female adult body colour and pigmentation are shown in Figs 72 and 73, respectively.

Gómez-Menor described *Bemisia medinae* from the laurel forest in Tenerife, from an "unknown plant amongst trees of *Laurus canariensis* [now *L. novocanariensis*]". Type material deposited at MNCN has been studied, as well as duplicate dry plant material. *Hypericum grandifolium* Choisy (Fam. Hypericaceae) is endemic in the Canary Islands and Madeira. It is a plant with a very wide altitudinal range (up to 2000 metres) and usually is present in open habitats and the edges of humid juniper-olive woodlands, the evergreen laurisilva and the pine forest. Examination of the original dry plant material suggests that *H. grandifolium* is the "unknown plant" stated by Gómez-Menor to be the host of *B. medinae*.

***Bemisia reyesi* Hernández-Suárez and Martin sp. n.**
(Figures 30, 56, 74, 75)

PUPARIUM (Fig. 30). *Habitus*. The immature stages occur in small groups, usually on the underside of the leaves of its hosts. Puparia secrete long white curls of opaque wax from the dorsum, completely obscuring the insects themselves (Fig. 56). Cuticle pale. *Margin*. Outline oval, 0.90mm long, 0.65mm wide, generally widest at abdominal segment I. Margin crenulate with tracheal openings not marked. *Dorsum*. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures reaching submarginal area. Submedian/subdorsal area of dorsal disc smooth; abdominal segmentation and meso-metathoracic division well marked, and abdominal segment VII significantly reduced in length medially; submedian abdominal depressions not marked. Vasiform orifice triangular, sides very subtly convex and apex rather rounded, with floor ridged and the presence of an apical "teeth", posteriorly there is a very narrow caudal furrow bordered by shallow caudal ridges, the vasiform orifice inset from puparial margin by approximately its own length or less; operculum cordate, occupying half of vasiform orifice. Lingula head rather ovoid, spinulose, included in vasiform orifice, with a pair of stout apical setae that extend beyond apex of Vasiform orifice. *Chaetotaxy.* Anterior and posterior marginal setae present, needle-like, posterior pair similar to caudal setae. Normal dorsal disc chaetotaxy comprises single submedian pairs of cephalic, eighth abdominal and first abdominal setae, all very short; eighth abdominal setae placed slightly anterior to widest part of operculum; a pair of submarginally-placed caudal setae present, hair-like; a row of 12 submarginal setae spine-like, most rather shorter and finer than 1st abdominal setae. *Pores*. Simple pores present scattered in subdorsal and submarginal area; two rows of the geminate pore/porette type in abdominal segments; from zero to two pairs of pore/porettes on each side between 1st abdominal setae (two pairs on either side of the median line, between the first abdiminal setae, is the norm in the *B. afer* complex—see Fig. 31). *Venter.* Cuticle smooth, diaphanous, not sculptured. Ventral abdominal setae underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs. Middle and hind legs each with a tiny basal setae. Antennal bases anteromesad and slightly longer than fore legs. Tracheal folds faintly stippled.

Etymology: This species is named in recognition of J. Alfredo Reyes-Betancort who contributed much material to this study and who provided identifications for many host plants.

Material examined: Holotype puparium: GRAN CANARIA, Pinar de Tamadaba, 07.xii.2002 (J.H.Martin #7740) on *Hypericum reflexum*. **Paratypes**: 39 puparia, 33 third-instar nymphs, 15 second-instar nymphs, 21 first-instar nymphs same data as holotype (BMNH); TENERIFE: dry material on leaves, Güímar, Barranco de Badajoz, 25.xi.2000 (Martin #7487); dry material on leaves, valley near La Punta del Hidalgo, 28.xi.2000 (Martin #7496; TENERIFE: 19 puparia and 1 third-instar nymph Cuevas Negras, 29.vi.1997 (J.A. Reyes coll.) on *H. reflexum*; 10 pupuria, 1 third-instar nymph and 1 adult female Barranco de Blas, 20.vii.1997 (J.A. Reyes coll.) on *H. reflexum*; 95 puparia, 9 third-instar nymph and 2 second-instar nymph Barranco Badajoz, 11.i.1998 and 25.i.1998 (E. Hdez. coll.) on *H. reflexum*; 1 puparia and 2 adult female. GRAN CANARIA: Los Tiles, 22.i.1998 (E. Hdez. Coll.) on *H. reflexum.* Other material observed: TENERIFE: Barranco de los Cochinos, Las Mercedes, Lomo de Abache. GRAN CANARIA: El Viso-Inagua (700msnm) 25.iv.2003, on *H. reflexum*.

Comments: *B. reyesi* is recognised immediately by its remarkable dorsal wax curls (Fig. 56), distinguishing it from all the other *Bemisia* species and forms in Macaronesia, and yet slide-mounted specimens reveal no apparent glandular structures. Takahashi established the genus *Lipaleyrodes* in 1962 with *L. phyllanthi* Takahashi as the type species. *Lipaleyrodes* Takahashi is now regarded as a junior synonym of *Bemisia* Quaintance and Baker (Dubey *et al*., 2009), as a result of comparative studies of puparial and adult characters of the nine species formerly included in *Lipaleyrodes*. Prior to the establishment of this synonymy, we had considerable difficulty in deciding on the generic placment of this new species; the waxy secretions suggested *Lipaleyrodes,* but the lack of any visible secretory glands rendered slide-mounted specimens more attributable to *Bemisia*. The lack of any visible structure associated with the secretion of the waxy curls remains notable and puzzling. In the Canaries, only *Aleurodicus dipersus* might possibly be mistaken for *B. reyesi* in the field, but the former is found only at very low altitudes on many different ornamental plants, and *B. reyesi* on one host only, at higher altitudes. Details of *Bemisia reyesi* adult body colour and sclerotic pigmentation are shown in Figs 74–75.

The puparial vasiform orifice in *Bemisia reyesi* tends to be more similar to the *tabaci*-group, but the presence of two pore/porettes on each side of median line between the 1st abdominal setae (seen in some puparia only) would place this species in *afer* group.

Hypericum reflexum (Fam. Hypericaceae), the only known host so far, is endemic to the Canary Islands (Gran Canaria, Tenerife and La Gomera). It grows on rocky slopes and in shady areas in evergreen forest from 300–1500 metres, sometimes in humid juniper-olive woodlands and humid pine forest.

***Bemisia tabaci* (Gennadius)**
(Figures 28, 29, 58)

Aleurodes tabaci Gennadius, 1889: 1–3.
Bemisia tabaci (Gennadius) Takahashi, 1936: 110.
Cortesiana restoniceae Goux, 1988: 64 [Synonymised by Martin, 1999: 59.]
inconspicua (Quaintance, 1900: 28–29) (*Aleurodes*) [Synonymised by Russell, 1957: 122.]
emiliae Corbett, 1926: 273 [Synonymised by Mound & Halsey, 1978: 118.]
costalimai Bondar, 1928: 27–29 [Synonymised by Russell, 1957: 122.]
signata Bondar, 1928: 29 [Synonymised by Russell, 1957: 122.]
bahiana Bondar, 1928: 30 [Synonymised by Russell, 1957: 122.]
gossypiperda Misra & Singh, 1929: 1 [Synonymised by Russell, 1957: 122.]
achyranthes Singh, 1931: 82 [Synonimised with *gossypiperda* by Corbett, 1935c: 783.]
hibisci Takahashi, 1933: 17 [Synonymised by Takahashi, 1936: 110.]
longispina Priesner & Hosney, 1934a: 6 [Synonymised by Russell, 1957: 122.]
gossypiperda var. mosaicivectura Ghesquière, 1934 in Mayné & Ghesquière, 1934: 30 [Synonymised by Russell, 1957: 122.]
goldingi Corbett, 1935a: 249 [Synonymised by Russell, 1957: 122.]
nigeriensis Corbett, 1935a: 250 [Synonymised by Russell, 1957: 123.]
rhodesiaensis Corbett, 1936: 22 [Synonymised by Russell, 1957: 123.]
manihotis Frappa, 1938: 30 [Synonymised by Takahashi & Mamet, 1952: 125.]
vassierei Frappa, 1939: 255 [Synonymised by Takahashi & Mamet, 1952: 125.]
lonicerae Takahashi, 1957: 16 [Synonymised by Mound & Halsey, 1978: 119.]

minima Danzig, 1964: 638 [Synonymised by Danzig, 1966: 372.]
miniscula Danzig, 1964: 640 [Synonymised by Danzig, 1966: 327.]
restonicae Goux, 1988: 64. (*Cortesiana*) [Synonymised by Martin, 1999: 59]
argentifolii Bellows & Perring in Bellows, Perring, Gill & Headrick, 1994: 196 [Synonymised by De Barro, Trueman & Frohlich, 2005: 201.]

Distribution in the Canary Islands: LANZAROTE: Arrecife, Cerro Terroso, Costa Teguise, Famara, Fariones, Femés, Granja del Cabildo, Playa Blanca, Puerto del Carmen, San Bartolomé, Soó. FUERTEVENTURA: Ajuí, Cañada del Río, Corralejo, Gran Tarajal, La Lajita, La Oliva, Nuevo Horizonte, Pájara, Puerto del Rosario, Vega del Río Palma. GRAN CANARIA: Arucas, Barranco Azuaje, La Aldea, Las Palmas de Gran Canaria, Mogán, San Agustín, San Nicolás, Telde, Vecindario. TENERIFE: Adeje, Agua Dulce, Altos de Güímar, Arafo, Arico, Bahía del Duque, Barranco Badajoz, Buenavista, Candelaria, Cuevas Negras, Geneto, Guamasa, Güía de Isora, La Laguna, La Barranquera, Las Galletas, Las Mercedes, La Orotava, Lomo de la Medida, Los Cristianos, Los Gigantes, Los Realejos, Los Silos, Pajalillos, Playa San Juan, Punta del Hidalgo, Puerto de la Cruz, San Isidro, Santa Cruz, Tagana, Valle Guerra. LA GOMERA: Jardín Tecina, Hermigua, Playa Santiago, Vallehermoso, Valle Gran Rey, San Sebastián. EL HIERRO: Ctra. Mocanes, Frontera, Los Llanillos, Pozo de la Salud, Sabinosa, Tamaduste, Tigaday. LA PALMA: Charco Verde, La Costa, Los Cancajos, El Paso, Los Sauces, Puerto Nao, Santa Lucia, Tazacorte. **Elsewhere:** Cosmopolitan in all warmer parts of the world.

Host plants in the Canary Islands: *Ageratina adenophora*, *Amaranthus sp.*, *Brassica oleracea, Capsicum annuum, Convolvulus canariensis, Crambe pritzelii, Cucumis melo, Cucumis sativus, Cucurbita ficifolia, Cucurbita maxima, Cucurbita pepo, Gerbera sp.*, *Gossypium sp.*, *Helianthus annuus, Hibiscus calyphyllus, Hibiscus rosa-sinensis, Hirschfeldia incana, Hypericum grandifolium, Ipomoea batatas, Lactuca serriola, Lantana camara, Launaea nudicaulis, Malva sp.*, *Malvaviscus penduliflorus, Nicotiana glauca, Nicotiana tabacum, Oxalis pes-caprae, Pelargonium sp.*, *Persea americana, Euphorbia pulcherrima, Punica granatum, Rosa sp.*, *Rubus ulmifolius, Solanum lycopersicum, Solanum muricatum, Solanum nigrum, Solanum tuberosum, Sonchus oleraceus, Spathodea campanulata, Tagetes patula*. **Other host plant listed*:*** numerous hosts have been recorded in many publications including Mound & Halsey (1978). Cock (1986) published a survey of the literature on *B. tabaci*, with 829 entries, and an update followed (Cock, 1993), which included many host records.

Comments: *B. tabaci* was regarded as a single morphologically-variable species with an exceptionally wide range of host plants, following the demonstration of the phenomenon of puparial plasticity by Mound (1963). However, more recent investigations have shown many field-collected populations ("biotypes") to have a narrow range of host plants, with some apparently monophagous. Indeed, Mound (personal communication) had found the successful transfer of populations from one host to another to be a great challenge during his experimental work on host-induced morphological variation. Several such population biotypes have been recognised for some years, but the development of new techniques for the study of cytology and molecular sequencing has led to many more biotypes being recognised (Brown, 2010). A situation of great complexity, controversy and nomenclatural confusion has now arisen, and this was compounded when "biotype B" was eventually given its own species name, *B. argentifolii* Bellows & Perring (in Bellows *et al.*, 1994), and its own common name, "silverleaf whitefly" (from the visible feeding damage caused to squash plants). However, the other recognised biotypes have not been treated in this way, with many workers agreeing that the naming of *B. argentifolii* was premature, and De Barro *et al.* (2005) placed it as a junior synonym of *B. tabaci*. Despite much work having been conducted on the various biotypes of the *B. tabaci*-group, great controversy remains. It is the situation with *B. tabaci* that has led us to be very cautious over naming taxa within *B. afer sens. lat.*, *q.v.*—see discussion on p.16

Genus *Dialeurodes* Cockerell

Aleyrodes (*Dialeurodes*) Cockerell, 1902: 283. Type species: *Aleyrodes citri* Ashmead, 1885, by original designation.
Dialeurodes Cockerell; as full genus, Quaintance & Baker, 1914: 97.
Lankaleurodes B.V.David, 1993: 23 [Synonymised by Martin & Mound, 2007: 28.]
Kanakarajiella B.V.David & Sundararaj, 1993: 289 [Synonymised by Martin & Mound, 2007: 28.]
Shaninthiae P.M.M.David, 2000: 125 [Synonymised by Martin & Mound, 2007: 28.]

Comments. Dialeurodes has traditionally been the most speciose whitefly genus. Following a cladistic review by Jensen (1999, 2001), resulting in many species being transferred to *Singhiella* or *Massilieurodes*, over 120 described species are still included in *Dialeurodes* (Martin & Mound, 2007), with *Aleuroclava* almost equally speciose. *Dialeurodes* is characterised by the following characters: outline usually oval, margin smooth but tracheal openings at margin always marked by a distinct pore, vasiform orifice very small in comparision with whole puparium, usually subcircular and fully occupied by operculum, with lingula often obscured (Martin, 2005). In *Dialeurodes sensu stricto*, which includes *D. citri*, below, the ventral tracheal folds are punctuated by tiny dots or stipples.

***Dialeurodes citri* (Ashmead)**
(Figures 32 & 81)

Aleyrodes citri Ashmead, 1885: 704.
Dialeurodes citri (Ashmead) Quaintance & Baker, 1916: 469.
citri Riley & Howard, 1893: 219. (*Aleyrodes)* [Synonymised by Quaintance & Baker, 1917: 408.]
eugeniae var. aurantii Maskell, 1896: 431. (*Aleurodes*) [Synonymised by Quaintance & Baker, 1914: 97.]
kuchinasii Sasaki, 1908: 55. (*Aleyrodes*) [Synonymised by Takahashi, 1951b: 19.]
tuberculatus Takahashi, 1932: 9. [Synonymised by Takahashi, 1958: 66.]
citri var. kinyana Takahashi, 1935: 43 [Synonymised by Mound & Halsey, 1978: 133.]
citri var. hederae Takahashi, 1936: 219 [Synonymised by Mound & Halsey, 1978: 133.]

Distribution in the Canary Islands: GRAN CANARIA: Arucas. **Elsewhere:** Palaeartic Region: Algeria, Corsica, Egypt, France, Greece, Israel, Italy, Lebanon, Malta, Morocco, Sardinia, Sicily, Spain, Tunisia, Turkey, Yugoslavia, Japan, Federation of Independent States. Oriental Region: China, Hong Kong, India, Pakistan, Sri Lanka, Taiwan, Thailand. Neotropical Region: Argentina. Neartic Region: USA (Florida).

Host plants in the Canary Islands: *Citrus reticulata***. Other listed host plants:** *D. citri* has been recorded feeding on a wide variety of other plants (Mound & Halsey, 1978) but it is most commonly associated with *Citrus* (Patti & Rapisarda, 1981; Martin *et al*., 2000).

Comments: *Dialeurodes citri* is a well known citrus pest, although its hosts also include many broad leaf trees (Jensen, 2001). *Dialeurodes citri* is characterised by having a colourless pupal case, broadly oval with margin smooth and tracheal areas differentiated as pores; eighth abdominal setae anterior to widest part of operculum; ventral tracheal folds punctuated by distinct stippling. In the field, crypsis renders feeding stages difficult to see unless in high numbers.

Genus *Parabemisia* Takahshi

Parabemisia Takahashi, 1952: 21. Type species: *Parabemisia maculata* Takahashi, 1952, by original designation.

Comments. The seven described species in this genus (Martin & Mound, 2007) are native to the Oriental and Austro-Oriental Regions and material of undescribed species is deposited in BMNH and USNM. *Parabemisia* puparia are characterised as follows: outline broadly oval, with thoracic tracheal areas not modified at margin; abdominal segment VII reduced in length medially; with a row of 12–14 pairs of fine outer-submarginal setae, first abdominal setae absent; vasiform orifice triangular to elongate-cordate, and caudal furrow not, or little, marked. One species, *P. myricae* (Kuwana), has extended its range to several regions of the world, often initially becoming an economic pest in areas of new introduction.

***Parabemisia myricae* (Kuwana)**
(Figures 33 & 82)

Bemisia myricae Kuwana, 1927: 249–251.
Parabemisia myricae (Kuwana) Takahashi, 1952: 24.

Distribution in the Canary Islands: TENERIFE: Valle Guerra. GRAN CANARIA: Arucas. **Elsewhere:** Palaeartic Region: Crete, Cyprus, Egypt, Greece, Italy, Sardinia, Sicily, Spain, Tunisia, Turkey, Japan; Ethiopian Region: Ivory Coast; Oriental Region: Hong Kong, India, Sri Lanka, Taiwan; Autro-Oriental Region: Malay Peninsula; Pacific Region: Hawaii; Neotropical Region: Mexico, Trinidad; Neartic Region: USA (California, Florida).

Host plants in the Canary Islands: *Citrus sinensis*. **Other host plant listed:** *P. myricae* has been listed from hosts in 14 plant families by Mound & Halsey (1978), but favoured hosts are *Citrus* spp. and *Persea americana*, especially in the Mediterranean basin (Martin *et al*., 2000)

Comments: Commonly called the "Japanese bayberry whitefly", *P. myricae* is a notable pest of subtropical plants, especially citrus crops and avocado, and was introduced into several countries in the Mediterranean Basin (Bink-Moenen & Gerling, 1990). It was first discovered in mainland Spain in 1990, in the citrus areas of Málaga (Garrido, 1994). It was recorded for the first time in the Canary Islands in 1997 by the local inspection services (Anonymous, 1997). This whitefly species is sometimes responsible for serious crop damage when it first arrives in a new geographical area, but usually soon settles into the background as natural controls become established. Pupal cases are colourless and cryptic, and are very difficult to see if not in high numbers. In the field, the eggs are laid on the leaf border, each producing a characteristic protuberance. Individuals of *P. myricae* excrete large quantities of honeydew but do not secrete visible waxy material (Fig. 82).

Genus *Siphoninus* Silvestri

Siphoninus Silvestri, 1915: 245. Type species: *Siphoninus finitimus* Silvestri, 1915, by original designation.

Comments. *Siphoninus* is principally characterised as follows: puparial dorsal surface with several rows of glandular structures termed siphons; vasiform orifice is not elevated and its floor is strongly ridged; operculum is small and lingula tip is exposed, operculum and lingula together filling about half of vasiform orifice; caudal tracheal comb present but thoracic combs absent. Four species are currently included—*S. finitimus* Silvestri, 1915: 247 described from *Olea chrysophylla* in Eritrea; *S. gruveli* Cohic, 1968: 50 described from *Combretum glutinosum* in Chad; *S. immaculatus* (Heeger, 1856: 33) described from *Hedera helix* in Germany and *S. phillyreae* (Haliday, 1835: 119) described from *Phillyrea latifolia* in Ireland. It should be noted that the whereabouts of type material of *S. finitimus, S. immaculatus* and *S. phillyreae* is unknown and the conclusions that follow are based upon descriptions and non-type material in BMNH.

In the field, *Siphoninus* colonies are easily recognised by the presence of elongate siphons on the puparial dorsum, usually visible with a good hand lens. Colonies are found in crowded groups under host leaves, covered by a fine layer of powdery white wax.

***Siphoninus finitimus* Silvestri stat. rev.**
(Figures 34 & 84)

Siphoninus finitimus Silvestri, 1915: 247–249.
Siphoninus phillyreae multitubulatus Goux, 1949: 11. **Revised synonymy**.

PUPARIUM (Fig. 34). *Habitus*. The immature stages occur in aggregations on the undersides of leaves of their host plants, usually covered by a fine white waxy secretion. Cuticle is pale with two discret dark spots around vas-

iform orifice and in cephalothorax (Fig. 84). *Margin*. Outline oval, 0.99mm long, 0.67mm wide [n=6], generally widest at abdominal segment I (n=6). Margin undulate with thoracic tracheal combs present. *Dorsum*. Longitudinal moulting suture reaching puparial margin; transverse moulting sutures reaching submarginal area. Submargin smooth. Submedian/subdorsal area of dorsal disc smooth; abdominal segmentation and meso-metathoracic division well marked and abdominal segment VII not significantly reduced in length medially; submedian abdominal depressions not marked. Vasiform orifice rounded-cordate, its floor with multiple cells which vary in number, the orifice inset from puparial margin by approximately its own length; operculum laterally-rounded trapezoidal, occupying less then half of vasiform orifice, its posterior margin finely setose; lingula head rounded, only slightly expanded, exposed. Caudal furrow not defined. *Chaetotaxy.* Anterior and posterior marginal setae present, hair-like, only slightly shorter than submarginal setae. Normal dorsal disc chaetotaxy comprises single submedian pairs of cephalic, eighth abdominal and first abdominal setae all hair-like and of similar length; eighth abdominal setae placed anterior to vasiform orifice; a pair of submarginally-placed caudal setae present plus a row of fourteen submarginal setae in each side. All submarginal setae hair-like. A row of 25–26 siphons, placed in submarginal-subdorsal area on each side of body; three pairs of siphons in cephalothorax and a variable number of siphons (from 6 to 9) of similar size in abdominal segments. *Pores*. Simple pores present; the simple pores not evidently of the geminate pore/porette type. *Venter*. Cuticle smooth, diaphanous. Ventral abdominal setae underlying vasiform orifice. Legs bisegmental and with apical adhesion pads directed anteriorly on the fore legs, and posteriorly on the middle and hind legs. Middle and hind legs each with a tiny basal setae. Antennal bases anterolateral to fore legs. Tracheal folds unpunctuated.

Distribution in the Canary Islands: TENERIFE: Las Mercedes. LA GOMERA: Chipude, Barranco Santiago. **Elsewhere:** Palaearctic Region: Corsica, Jordan, Spain; Ethiopian Region: Eritrea, Ethiopia; Neotropical Region: Chile, Peru.

Host plants in Canary Island: *Picconia excelsa.* **Other host plants listed:** *Olea europaea* (Corsica, quoted host of *S. phillyreae multitubulatus* and host of BMNH sample), *Olea chrysophylla* (Eritrea, quoted host of *S. finitimus*), "olive", *Olea* sp. (Chile, Peru), *Olea africana* (Ethiopia).

Comments: There has been controversy concerning the significance of variation in the number, length and distribution of dorsal glandular siphons on puparia of *Siphoninus* species. Material collected in Europe on a particular host, but in different seasons, shows no significant variation. Also, there seems not to be a simple correlation between the host plant and siphon length. However, the number, distribution and length of puparial siphons does, now, appear to be of significance in delimiting some species (Table 1), and has led us here to reinstate *S. finitimus* as a valid species, with *S. phillyreae multitubulatus* becoming a synonym of *S. finitimus* rather than of *S. phillyreae*.

Material of *S. phillyreae* from rosaceous hosts in Spain, Italy, France and England has been examined, including material from *Cotoneaster, Crataegus*, and *Pyrus* (Table 1), along with material from *Fraxinus*. There is variation in siphon number but an average of 50 siphons (46–52) are always present in the submarginal area, with 2 submedian pairs in the cephalothorax and from 6 to 10 submedian siphons on abdominal segments. The mean length of submarginal siphons in *S. phillyreae* is 0.08mm (0.06mm to 0.09mm, N=38). The mean size of puparia is 0.87mm long and 0.63mm width.

Silvestri described *S. finitimus* from *Olea chrysophylla* in Eritrea, based on the number and length of its siphons, with a total of 75–79 dorsal siphons with an average length of 0.084–0.098 mm. There is also material from Ethiopia in BMNH, identified as *S. finitimus* (three slides with following data: Ethiopia, Sebeta, ex *Olea africana*, 27.xi.1975, D.J.Greathead, sample nº 38b CIE A8481): the mean submarginal siphon length is 0.15mm, with 53–81 submarginal siphons present, plus 2 cephalothoracic and (6–10) submedian abdominals. Goux (1949) discussed several subspecies based on the number and length of siphons. He described *S. phillyreae multitubulatus* from *Olea europaea* L. in Corsica, based on its larger size and more numerous and larger siphons in the submarginal area (mean number of 35 to 45). He mentioned that both *S. finitimus* Silvestri and *S. inaequalis* (Gautier) presented a variable number of submedian siphons in the abdominal segments but always have two pairs in cephalothoracic region. Mound & Halsey (1978: 192) placed *S. finitimus* and *S. phillyreae multitubulatus* as junior synonyms of *S. phillyreae* (Haliday), along with other taxa—see account of *S. phillyreae* below. We now consider

S. finitimus to be a distinct species (**stat. rev.**), with *S. phillyreae multitubulatus* its junior synonym (**revised synonymy**).

Independently, similar observations to our own have been made recently by Valencia (2011) who has documented differences between puparia and adult whiteflies from populations on olive and pomegranate in Peru, as well as differences in parasitoid preference.

In the Azores, a completely different siphon-morphology has been observed on the puparia of populations on *Picconia azorica*, the same plant genus that hosts *S. finitimus* in the Canaries, indicating that siphon numbers and distribution are important diagnostic characters. We consider that the species found on *Picconia* in the Azores represents an undescribed species.

TABLE 1. *Siphoninus* species—geographical localities, hosts, puparial dimensions, siphon counts and lengths.

Siphoninus population	Locality	Host	Puparial length	Puparial width	Nº siphons in submarginal area	Nº siphons in median area	Length submarginal siphons
S. phillyreae	Canary Is., Spain, England, Italy, Corsica, Greece, Libya	Crataegus, Olea, Fraxinus, Malus, Punica	0.87 (0.73–1.0)	0.63 (0.50–0.79)	50 (46–52)	10 (8–13)	0.08 (0.06–0.09)
***Siphoninus* sp.n.**	Azores	*Picconia azorica*	0.79 (0.76–0.83)	0.57 (0.53–0.62)	46 (42–51)	0	0.09 (0.09–0.1)
S. finitimus	Canary Islands	*Picconia excelsa*	0.99 (0.94–1.07)	0.66 (0.55–0.78)	62 (53–81)	8 (6–10)	0.13 (0.1–0.18)
S. finitimus	Ethiopia,Jordan, Spain	Olea	0.91 (0.83–0.98)	0.65 (0.59–0.7)	62 (53–81)	11 (8–13)	0.1 (0.09–0.13)

***Siphoninus phillyreae* (Haliday)**
(Figure 35)

Aleyrodes phillyreae Haliday, 1835: 119.
Siphoninus phillyreae (Haliday) Silvestri, 1915: 247.
phylliceae Bouché, 1851: 110. (*Aleurodes*). [Synonymised by Frauenfeld, 1867: 796.]
dubia Heeger, 1859: 223. (*Aleyrodes*). [Synonymised by Frauenfeld, 1867: 796.]
inaequalis Gautier, 1923: 339. (*Trialeurodes*). [Synonymised by Mound & Halsey, 1978: 192.]
granati Priesner & Hosney, 1932:1. [Synonymised by Mound & Halsey, 1978: 192.]

Distribution in the Canary Islands: LANZAROTE: Haría. FUERTEVENTURA: Betancuria, Esquinzo, Morrojable, Pájara, Puerto del Rosario, Vega del Río Palma. TENERIFE: Bahía del Duque. GRAN CANARIA: Barranco Cernícalos, La Aldea, Los Moriscos. **Elsewhere:** Palaearctic Region: widespread in Europe and Mediterranean countries, except Scandinavia; Ethiopian Region: Cameroun, Sudan. Oriental Region: India, Pakistan. Australia: New South Wales, South Australia. Pacific Region: New Zealand. Neotropical Region: Mexico, Peru. Nearctic Region: USA (California).

Host plants in the Canary Islands: *Punica granatum*. **Other host plants listed:** This species is oligophagous and occurs most commonly on woody members of the Oleaceae (*Fraxinus*, *Olea, Phillyrea*), Lythraceae and Rosaceae (*Cotoneaster, Crataegus*, *Malus*, *Pyrus*, etc).

Comments: The variable number of dorsal puparial siphons has been the cause of a proliferation of species names in *Siphoninus*, but most were proposed as synonyms of *S. phillyreae* by Mound & Halsey (1978). As discussed above, we now consider that *S. finitimus* Silvestri is a valid species with *S. phillyreae multitubulatus* Goux its junior synonym.

S. phillyreae is commonly known as the Ash whitefly despite its range of other hosts. It was recorded in mainland Spain, from *Crataegus oxycantha* in Madrid Botanic Garden by Gómez-Menor (1943), and in the Canary Islands on *Punica granatum* by Peña (1994). It is probably a native of Europe and the Mediterranean Basin, but was introduced into California (USA) in the late 1980s, where it caused severe damage to shrubs and ornamental trees (Sorensen *et al*., 1990), and also into Australia and New Zealand where it also became a pest (Martin, 1999). At the end of the twentieth century, *Siphoninus* was discovered in Chile and Peru, South America (Valencia, 2010).

Puparia of *S. phillyreae* can be distinguished by having a single area of dark submedian coloration, whereas *S. finitimus* has the cuticle mostly pale but with two distinct areas of infuscation in the median area of the dorsum.

Priesner & Hosny (1932) mentioned from two to three annual generations for this species. Patti & Rapisarda (1981) listed several natural enemies such as *Encarsia inaron* and *E. siphonini* (Hymenoptera: Aphelinidae), along with several predators like *Clitostethus arcuatus* (Rossi) (Coleoptera: Coccinellidae) and *Acletoxenus formosus* Loew (Diptera: Drosophilidae). In the Canary islands, *S. phillyreae* is naturally parasitized by *E. inaron* (Hernández-Suárez *et al*., 2003).

Genus *TRIALEURODES* Cockerell

Aleyrodes (*Trialeurodes*) Cockerell, 1902: 283. Type species : *Aleurodes pergandei* Quantance, 1900, by original designation.
Trialeurodes Cockerell; Quaintance & Baker, 1915: xi.
Gymnaleurodes Sampson & Drews, 1940: 29 [Synonymised by Sampson, 1943: 209.]
Ogivaleurodes Goux, 1948: 31 [Synonymised by Mound & Halsey, 1978: 205.]
Trialeurodes (*Ericaleyrodes*) Rapisarda, 1986: 490 [Synonymised by Martin & Mound, 2007: 46.]

Comments. *Trialeurodes*, although cosmopolitan, is predominately a New World genus. The genus currently comprises 63 species (Martin & Mound, 2007) characterised by the following combination of characters: mature puparium with the dorsal surface elevated from leaf and surrounded by a waxy palisade; submargin with glandular papillae; abdominal segment VII much reduced in length medially; vasiform orifice cordate, posteriorly well-defined, lingula partly covered by operculum and with a characteristic lobulate head (Martin, 1999).

Trialeurodes ricini (Misra)

(Figures 36, 37, 83, 95)

Aleyrodes ricini Misra, 1924: 131.
Trialeurodes ricini (Misra) Singh, 1931: 46.
rara Singh, 1931: 47 [Synonymised by Bink-Moenen, 1983: 185.]
desmodii Corbett, 1935a: 243 [Synonymised by Mound & Halsey, 1978: 217.]
lubia El Khidir & Khalifa, 1962: 47 [Synonymised by Mound, 1965a: 157.]

Distribution in the Canary Islands: GRAN CANARIA: Arucas, Las Palmas de Gran Canaria, Marzagán. TENERIFE: Punta del Hidalgo, Santa Cruz de Tenerife, Taganana. LA GOMERA: Playa Santiago, Valle Gran Rey. **Elsewhere:** Palaeartic Region: Egypt, Iran, Iraq, Saudi Arabia; Ethiopian Region: Ivory Coast, Kenya, Malawi, Nigeria, Sierra Leone, Sudan, Uganda; Oriental Region: Hong Kong, India, Pakistan, Thailand; Austro-oriental Region: Brunei, Philippines.

Host plants in the Canary Islands: *Cucurbita* sp*., Ricinus communis*. **Other host plants listed:** *Cucurbita maxima*, *Gossypium hirsutum*, *Hibiscus cannabinus*. Eight plant families were listed by Mound & Halsey (1978) and another fourteen by Bink-Moenen (1983).

Comments: *Trialeurodes ricini* is a polyphagous species but it is most commonly associated with the castor oil plant, *Ricinus communis* (Bink-Moenen, 1983), on which host it may occur in extremely dense colonies (Fig. 95). *Trialeurodes ricini* also occurs frequently on *Curcurbita* in Margazan (Gran Canaria), near heavily infested *Ricinus* plants (Malumphy, personal observations).

Trialeurodes ricini can be distinguished from *T. vaporariorum*, also present in the Canary Islands, by the large basal spines on the middle and hind legs (Fig. 37), which are not present in *T. vaporariorum* (Fig. 38). In the field,

T. ricini can be distinguished by the presence of long and flat translucent wax-filaments forming a broad fringe around the margin of the puparium (Fig. 83). Occasionally, most or all of these filaments may be almost vertically directed. Also, nymphs of *T. ricini* are gregarious and usually yellowish in colour (in contrast to the more sparsely-distributed and creamy-coloured puparia of *T. vaporariorum*).

The taxonomic separation of this species from *T. lauri* Signoret was discussed by Martin *et al*. (2000), who suggested that *T. lauri* could be a variant form of *T. ricini*. Recently, both morphological and molecular data has supported their retention as two distinct species that can be separated by the absence (*lauri*) or presence (*ricini*) of a pair of cephalic setae (Malumphy *et al*. 2007). In Egypt, *T. ricini* has been reported as a vector of the begomovirus *Tomato yellow leaf curl virus* (TYLCV) (Idriss *et al*. 1998), but these results were not supported by other studies.

***Trialeurodes vaporariorum* (Westwood)**
(Figures 38 & 85)

Aleyrodes vaporariorum Westwood, 1856: 852.
Trialeurodes vaporariorum (Westwood) Quaintance & Baker, 1915: xi.
lecanioides Maskell, 1879: 215. (*Asterochiton*) [Synonymised by Quaintance & Baker, 1914: 105.]
papillifer Maskell, 1890: 173. (*Aleurodes*). [Synonymised by Quaintance & Baker, 1914: 105.]
nicotianae Maskell, 1896: 436. (*Aleurodes*). [Synonymised by Quaintance & Baker, 1914: 105.]
sonchi Kotinsky, 1907: 97. (*Aleyrodes*). [Synonymised by Baker & Moles, 1921: 645.]
mossopi Corbett, 1935b: 9 [Synonymised by Russell, 1948: 43.]
natalensis Corbett, 1936: 18 [Synonymised by Russell, 1948: 44.]
sesbaniae Corbett, 1936: 19 [Synonymised by Russell, 1948: 44.]

Distribution in the Canary Islands: LANZAROTE: Arrecife, Las Breñas, Costa Teguise, Haría, Puerto del Carmen. FUERTEVENTURA: Cañada del Río, Corralejo, Gran Tarajal, La Lajita, Nuevo Horizonte, Pájara. GRAN CANARIA: Arucas, Arinaga, Barranco de Guayadeque, La Aldea, Las Palmas de Gran Canaria, Mogán, Moya, San Nicolás, Telde, Teror, Vecindario. TENERIFE: Adeje, Agua Dulce, Agua Mansa, Arico, Bahía del Duque, Barranco de Badajoz, Barranco de los Cochinos, Buenavista, Cuevas Negras, La Orotava, La Barranquera, La Laguna, La Perdoma, Las Eras, Las Galletas, Las Mercedes, Los Realejos, Los Silos, Icod, Güímar, Guía de Isora, Playa San Juan, Puerto de la Cruz, Punta Hidalgo, Santa Cruz de Tenerife, Valle Guerra. LA GOMERA: Barranco de Santiago, El Cedro, Jardín Tecina, Langrero, Hermigua, Playa Santiago, Vallehermoso, Valle Gran Rey. EL HIERRO: Road Mocanal, Frontera, Gorreta, Los Llanillos, Pozo de la Salud, Sabinosa, Tamaduste, Valverde. LA PALMA: Barlovento, Charco Verde, road Tazacorte, El Paso, El Roque, La Costa, Los Cancajos, Los Llanos, Los Nacientes, Los Sauces, Los Tilos, Santa Lucía, Santa Cruz de la Palma, Tazacorte. **Elsewhere**: cosmopolitan.

Host plants in the Canary Islands: *Abutilon grandifolium, Ageratina adenophora, Amaranthus cruentus, Amaranthus lividus, Bidens pilosa, Canarina canariensis, Capsicum annuum, Castanea sativa, Convolvulus canariensis, Cucumis sativus, Cucurbita ficifolia, Cucurbita maxima, Cucurbita pepo, Euphorbia atropurpurea, Euphorbia balsamifera, Forsskaolea angustifolia, Gerbera sp.*, *Gossypium sp.*, *Helianthus annuus, Hibiscus calyphyllus*, *Hibiscus cannabinus, Hibiscus rosa-sinensis, Hyoscyamus albus, Ipomoea batatas, Lactuca sativa, Lactuca serriola, Lantana camara, Solanum lycopersicum*, *Malva sp.*, *Marcetella moquiniana, Mentha spicata, Nerium oleander, Nicotiana glauca, Nicotiana tabacum*, *Oxalis pes-crapae*, *Parietaria judaica*, *Pelargonium* sp., *Persea americana, Phaseolus vulgaris, Euphorbia pulcherrima, Punica granatum, Ricinus communis, Robinia pseudoacacia*, *Salvia officinalis, Sechium edule, Solanum tuberosum, Sonchus oleraceus, Sonchus* sp. , *Tagetes patula*, *Thymus vulgaris, Tropaeolum* sp. **Other host plants listed**: Extremely polyphagous, recorded from more than 200 plant genera by Mound & Halsey (1978) and from many more since.

Comments: *Trialeurodes vaporariorum* is well known as a worldwide pest commonly called the "glasshouse whitefly", "greenhouse whitefly" or simply "*T. vap*". It was described from specimens collected in England in 1856; Westwood opined (almost certainly correctly) that it was of American origin. It was already moving around the world through trade, and had appeared in Australia by 1900 (Martin, 1999). It is considered that it represents one of the most economically important whitefly species, together with *Bemisia tabaci* (Martin *et al*., 2000). Hill

(1969) produced a comparative study in which all the different stages of *Bemisia tabaci* and *Trialeurodes vaporariorum* were compared to enable their recognition. Malumphy *et al*. (2009) produced a morphological and molecular comparative study of all developmental stages of *B. afer sens lat., B. tabaci, T. ricini* and *T. vaporariorum*, as these four species are commonly transported in international plant trade. *Trialeurodes vaporariorum* was first recorded in mainland Spain by Gómez-Menor (1943) and first reported from the Canary Islands by Gómez-Menor, in 1954. There are a considerable number of studies in the archipelago that have dealt with its pest status, population dynamics (Rodríguez-Rodríguez, 1978) or its biological control by the aphelinid parasitoid *Encarsia formosa* (Carnero & Barroso-Espinosa, 1985; Carnero *et al*., 1986; Barroso-Espinosa *et al*., 1989; Carnero *et al*., 1989). In the field, this species can be recognised because its dorsum is elevated from the substrate and its margin is surrounded by a rim of transparent wax and a fringe of translucent long waxy "fingers" (Fig. 85). On slides the two Canary Islands species of *Trialeurodes* can be distinguished as discussed in the comments on *T. ricini*, above.

Subfamily ALEURODICINAE Quaintance & Baker, 1913

DIAGNOSIS—puparia of all species found in Macaronesia are characterised by the presence of wax-producing compound pores in subdorsum, lingula is large and tongue-shaped, extending beyond posterior margin of vasiform orifice and bearing 4 long setae; legs are without adhesion pads but each bears an apical claw.

Genus *Aleurodicus* Douglas

Aleurodicus Douglas in Morgan, 1892:32. Type species: *Aleurodicus anonae* Morgan (a synonym of *A. cocois* Curtis) by subsequent designation of Quaintance, 1908: 8.
Aleurodicus (*Lecanoideus*) Quaintance & Baker, 1913: 70
Lecanoideus Quaintance & Baker; Costa Lima, 1928: 133. [Synonymised with *Aleurodicus* by Martin, 2008: 14].

Comments. The genus *Aleurodicus* was revised by Martin (2008) and currently comprises 35 described species. *Aleurodicus* puparia are characterised by having 4 pairs of large subdorsal abdominal compound pores, and most species also with one or two much smaller abdominal pairs posterior to the other four; 12 pairs of submarginal setae, and submedian cephalothoracic setae, present; submargin and/or dorsal disc usually punctuated by pores of several types.

Lecanoideus was described as a subgenus of *Aleurodicus*, but was later raised to full genus by Costa-Lima (1928). Martin *et al.* (1997: 1269–1270) had already suggested the need for a revision of the genus, and Martin (2008) concluded that *Lecanoideus* should be regarded as a junior synonym of *Aleurodicus*.

Aleurodicus dispersus Russell

(Figures 39, 86–88, title page image)

Aleurodicus dispersus Russell, 1965: 49–54.

Distribution in the Canary Islands: LANZAROTE: Puerto del Carmen, Playa Blanca, Fariones, Costa Teguise, Arrecife. FUERTEVENTURA: Corralejo, Cañada del Río. GRAN CANARIA: Arucas, San Agustín, Playa del Inglés, Las Palmas de Gran Canaria, Maspalomas, Puerto de Mogán. TENERIFE: Santa Cruz, Puerto Cruz, Punta del Hidalgo, Playa San Juan, Los Gigantes, Güímar, Bahía del Duque, Parque Eólico, Las Américas, Los Cristianos, Arona, Adeje, Guía de Isora, Las Américas, San Miguel, Santiago del Teide, Santa Cruz, Puerto de la Cruz. LA GOMERA: San Sebastián. EL HIERRO: Las Puntas. **Elsewhere**: Neotropical Region: widely distributed; Neartic Region: U.S.A. (Florida); Palaeartic Region: Madeira; Ethiopian Region: Cameroun, Congo, Benin, Ghana, Guinea-Bissau, Kenya, Nigeria, Sao Tomé, Tanzania, Togo; Malagasian Region: Mauritius; Oriental Region: Hainan (China), India, Maldives, Sri Lanka, Taiwan, Thailand, Vietnam; Austro-Oriental and Pacific Regions: widely distributed; Australia: Queensland.

Host plants in the Canary Islands: *Acacia* sp., *Acalypha wilkesiana*, *Acokanthera oblongifolia*, *Aloe arborescens*, *Archontophoenix alexandrae*, *Bauhinia variegata*, *Beta vulgaris*, *Bougainvillea* sp., *Bougainvillea spectabi-*

lis, *Brachychiton discolor*, *Capsicum annuum*, *Carica papaya*, *Coccoloba uvifera*, *Cocos nucifera*, *Cordia myxa*, *Eugenia uniflora*, *Dracaena draco*, *Ficus elastica*, *Ficus lyrata*, *Ficus microcarpa, Ficus* sp., *Ficus rubiginosa* var. *rubiginosa* and var. *glabrescens*, *Hibiscus rosa-sinensis*, *Howea forsteriana*, *Lantana camara*, *Limonium* sp., *Mackaya bella*, *Mangifera indica*, *Musa acuminata*, *Musa* sp., *Myoporum laetum*, *Myrica faya*, *Nerium oleander*, *Passiflora edulis*, *Phoenix canariensis*, *Phoenix* sp., *Plumeria alba*, *Psidium guajava*, *Psidium* sp., *Punica granatum*, *Roystonea regia*, *Schefflera* sp., *Schinus terebinthifolius*, *Senecio petasitis*, *Solandra maxima*, *Solanum argentinum*, *Solanum* sp., *Spathodea campanulata*, *Strelitzia alba*, *Strelitzia nicolai*, *Terminalia catappa*, *Vitis vinifera*, *Washingtonia filifera*, *Washingtonia robusta*, *Yucca aloifolia*, *Yucca* sp. **Other host plant listed:** this species is extremely polyphagous.

Comments: Native to the Neotropical Region, *Aleurodicus dispersus* is a notorious polyphagous pest commonly known as the "spiralling whitefly" [spelt "spiraling" in the USA]. It is one of the best-known of all *Aleurodicus* species because, through the 1980s and 1990s, it became almost pan-tropical in distribution, and caused much economic damage on its first arrival in many places (Martin, 1990 and personal observations).

Aleurodicus dispersus can be distinguished from most other *Aleurodicus* species by having 4 pairs of large abdominal compound pores but no smaller compound pores on abdominal segments VII or VIII, and by having a band of submarginal notched pores continuous posterior to vasiform orifice, with such pores absent from the median part of abdominal segment VII (Fig. 39).

In the description of *A. dispersus*, the holotype was selected from material from Florida; however, specimens from *Schinus terebinthifolius* in Gran Canaria were listed as paratypes by Russell (1965). Manzano *et al*. (1995) highlighted the rapid expansion of this whitefly within the Canary Islands and its extraordinarily wide range of hosts. It is now present in all the islands of the archipelago (Hernandez-Suárez *et al*., 2002).

The presence of *A. dispersus* in the Canary Islands probably obscured the introduction of a second species into the archipelago, *A. floccissimus* Martin *et al*. (*q.v.*, below), because they are very similar in appearance in the field (compare Figs 86–88 with Figs 89–91). However, *A. dispersus* can be distinguished from *A. floccissimus* in both adult and pupal stages. Adults of *A. dispersus* possess four grey spots on the fore wings (Fig. 87) and the puparial stages are smaller than in *A. floccissimus*. In the Canary Islands puparia of *A. floccissimus* almost always possess a pair of small compound pores on abdominal segment VIII, underneath the lingula (Fig. 40), a character that immediately distinguishes them from those of *A. dispersus*: however, in the absence of these small compound pores *A. floccissimus* may be distinguished by the many fewer notched pores in the subdorsal / submedian area, and by the axial processes of the abdominal compound pores usually directed posterolaterad in slide-mounted specimens. Also, the two species have characteristic waxy secretions that enable them to be distinguished one from the other when these secretions are in perfect condition (perfect puparia of *A. dispersus* are shown in Fig. 88). The spiralling whitefly is naturally controlled in the Canaries by *Encarsia hispida* (De Santis) (Hymenoptera: Aphelinidae) and also by the introduced *Encarsia guadeloupae* Viggiani (Hernández-Suárez *et al*., 2003; Nijohf *et al*., 2000).

Aleurodicus floccissimus (Martin, Hernández-Suárez & Carnero)

(Figures 40, 89–91)

Lecanoideus floccissimus Martin, Hernández-Suárez & Carnero, 1997: 1262.
Aleurodicus floccissimus (Martin, Hernández-Suárez & Carnero) Martin, 2008: 32.

Distribution in the Canary Islands: TENERIFE: Adeje, Agua Dulce, Arona, Bahía del Duque, Garachico, Geneto, Güímar, Guía de Isora, Las Américas, Las Galletas, Los Cristianos, Los Gigantes, Los Realejos, Puerto de la Cruz, Playa San Juan, Santa Cruz de Tenerife, San Juan de La Rambla, Tembel, Valle Guerra. GRAN CANARIA: Arucas, Las Palmas de Gran Canaria, Maspalomas, Puerto Rico. LA GOMERA: Hermigua. LA PALMA: Los Cancajos. **Elsewhere:** Neotropical Region: Colombia, Ecuador, French Guiana, Mexico, Peru, Trinidad.

Host plants in the Canary Islands: *Acalypha wilkesiana, Alpinia zerumbet, Apollonias barbujana, Archontophoenix alexandrae, Archontophoenix cunninghamiana, Syagrus romanzoffiana, Arenga pinnata, Artocarpus altilis, Bambusa sp., Bauhinia variegata, Bougainvillea spectabilis, Brachychiton discolor, Brahea armata, Brahea*

brandegeei, Caryota urens, Chamaerops humilis, Chamaedorea costaricana, Dypsis lutescens, Coccoloba uvifera, Cocos nucifera, Cordyline australis, Cordyline fruticosa, Costus megalobractea, Dictyosperma album, Doryanthes palmeri, Dracaena draco, Ficus benjamina, Ficus macrophylla, Ficus microcarpa, Ficus sp., Ficus religiosa, Heliconia bihai, Heliconia champneiana, Howea forsteriana, Livistona chinensis, Malvaviscus penduliflorus, Mangifera indica, Hyophorbe verschaffeltii, Monstera deliciosa, Musa acuminata, Musa sp., Musa textilis, Nicotiana glauca, Polyscias guilfoylei, Philodendron selloum, Phoenix canariensis, Phoenix dactylifera, Phoenix roebelenii, Pittosporum tobira, Plumeria alba, Plumeria rubra f. acutifolia, Psidium guajava, Ravenala madagascariensis, Roystonea borinquena, Rhapis humilis, Rhopalostylis baueri, Rhopalostylis sapida, Schinus terebinthifolius, Senecio grandifolius, Solandra maxima, Stenocarpus sinuatus, Strelitzia alba, Strelitzia nicolai, Strelitzia sp., Thrinax radiata, Trachycarpus fortunei, Trachycarpus martianus, Trachycarpus wagnerianus, Veitchia joannis, Veitchia montgomeryana, Washingtonia filifera, Washingtonia robusta, Wigandia caracasana, Zingiber sp., Zingiber zerumbet. **Other host plants listed:** *Elais guineensis, Inga sp., Theobroma cacao*.

Comments: As happened with *A. dispersus*, *A. floccissimus* was described from material collected in the Canary Islands although it, too, was clearly an introduction from the neotropics. At the time of its description parasitised puparial material from Ecuador was found in the BMNH collection confirming that this was indeed an introduction from the New World (Martin *et al*. 1997).

Aleurodicus floccissimus is now a notorius pest in the Canary Islands (Hernández-Suárez *et al*., 2002). Its economic impact can be highlighted by its range of host plants, that in Tenerife Island alone had risen to 94 different plant species (Hernández-Suárez *et al*., 2000). In 1998, the Cabildo of Tenerife made the first attempt at biological control of this pest by the introduction of the exotic parasitoid *Encarsia guadeloupae* Viggiani (Hymenoptera: Aphelinidae) (Nijhof *et al*., 2000). This introduction did not give the desired results so an enhanced effort is currently being made (unpublished data). Currently, *A. floccissimus* is now established as a pest of cacao in Mexico (Cortez-Madrigal *et al*., 2006), and it still has considerable economic impact in the Canaries.

In the field, in the Canary Islands, perfect or near-perfect specimens of *A. floccissimus* can be recognized by the arrangement of white wax secretions on the dorsum, combined with broader egg-laying trails (Figs 90, 91) and its adults are larger than those of *A. dispersus* and are without infuscated spots on the wings (Fig. 90).

Genus Paraleyrodes Quaintance

Paraleyrodes Quaintance, 1909: 169. Type species: *Aleurodes perseae* Quaintance, 1900, by monotypy.

Comments. Paraleyrodes species are considerably smaller than most other members of the Aleurodicinae. Puparia of this genus are characterised by having 5 or 6 pairs of abdominal compound pores but the cephalic and posterior 4 pairs of abdominal compound pores are usually conspicuously larger than the anterior 1 or 2 abdominal pairs; 14 pairs of submarginal setae present, plus a pair of cephalic setae, but thoracic submedian setal pairs absent. Adults of this genus are unique amongst known whiteflies, with species most reliably diagnosed from the structure of male aedeagus (Martin, 1996). Adults of *Paraleyrodes* are also unusual because the females have 4 articulated antennal segments and the males have only 3 antennal segments; also, their wings do not have branched veins.

Paraleyrodes minei Iaccarino

(Figures 41, 92, 93)

Paraleyrodes minei Iaccarino, 1990: 132.

Distribution in the Canary Islands: TENERIFE: Santa Cruz de Tenerife. GRAN CANARIA: Arucas, Las Palmas de Gran Canaria, Marzagán, Puerto de Mogán, San Bartolomé, Telde. LA PALMA: Tazacorte. LA GOMERA: San Sebastián, Valle Hermoso. **Elsewhere:** Neotropical Region: Belize, Guatemala, Mexico, Puerto Rico; Nearctic Region: Bermuda, California, Florida, Texas; Palaeartic Region: Lebanon, Morocco, Spain, Syria, Turkey; Ethiopian Region: Benin; Oriental Region: Hong Kong; Austro-oriental Region: West Malaysia; Pacific Region: Hawaii.

Host plants in the Canary Islands: *Citrus limon, Citrus sinensis, Citrus* sp., *Hibiscus* sp., *Cocos nucifera, Syagrus romanzoffiana*, *Strelitzia augusta*. **Other listed host plants:** It has being recorded from *Citrus aurantium*, *C. limon* in Spain (Llorens Climet & Garrido Vivas, 1992). A small colony of *P. minei* in Hong Kong was found on a most unusual host for any aleurodicine whitefly species—*Miscanthus sinensis* (Poaceae) (Martin, 2004, BMNH). *P. minei* is polyphagous everywhere it occurs.

Comments: *Paraleyrodes minei*, the so-called "nesting whitefly", is another example of a whitefly species that was described following its introduction to a new area and establishment as a pest, in this case from specimens collected in Syria. It is native to the neotropics, as are all other species in the genus. Two other *Paraleyrodes* species, *P. bondari* Peracchi and *P. citricolus* Costa Lima, have recently become established in Madeira (Martin, 1996). An identification guide to the species of this genus present in the western Palaeartic was provided by Martin (1996). *Paraleyrodes minei* is not an economic pest in the Canaries' citrus orchards but it is spreading as a pest of ornamental palms.

Females of *P. minei* secrete waxy material around themselves and they oviposit within these tiny "nests" (Fig. 92), giving rise to the common name but this is a characteristic of most *Paraleyrodes* species, so use of the common name is discouraged. In the field in the Canaries, *P. minei* can be recognised by the secreted wax, very small adults, and the males' antennal flagellum comprising a single, thick and usually orangy-coloured segment; each female usually occupies her nest formed from white waxy material (Fig. 92); puparia are surrounded by (and sometimes covered by) filamentous translucent wax rods that extend from the dorsum (Fig. 93).

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APPENDIX 1. Numbered check list of named Canary Islands whiteflies and forms discussed in detail.

- The serial number of each species or form corresponds to the numbers against each plant name in Appendix 2.

Subfamily ALEYRODINAE Westwood, 1840

1 *Acaudaleyrodes rachipora* (Singh)
2 *Aleurothrixus floccosus* (Maskell)
3 *Aleurotrachelus atratus* Hempel
4 *Aleurotulus nephrolepidis* (Quaintance)
5 *Aleyrodes proletella* (Linnaeus)
6 *Aleyrodes laurisilvae* Hernández-Suárez & Martin **sp. n.**
7 *Aleyrodes bencomiae* Hernández-Suárez & Martin **sp. n.**
8 *Bemisia afer* (Priesner & Hosny) *sens. lat.*
9 *Bemisia afer sens lat.* form A
10 *Bemisia afer sens lat.* form B
11 *Bemisia afer sens lat.* form C
12 *Bemisia afer sens lat.* form D
13 *Bemisia afer sens lat.* form E
14 *Bemisia afer sens lat.* form F
15 *Bemisia afer sens lat.* form G
16 *Bemisia afer sens lat.* form H
17 *Bemisia euphorbiarum* Hernández-Suárez & Malumphy **sp. nov.**
18 *Bemisia medinae* Gómez-Menor
19 *Bemisia reyesi* Hernández-Suárez & Martin **sp. n.**
20 *Bemisia tabaci* (Gennadius)
21 *Dialeurodes citri* (Ashmead)
22 *Parabemisia myricae* (Kuwana)
23 *Siphoninus finitimus* Silvestri **stat. rev.**
24 *Siphoninus phillyreae* (Haliday)
25 *Trialeurodes ricini* (Misra)
26 *Trialeurodes vaporariorum* (Westwood)

Subfamily ALEURODICINAE Quaintance & Baker, 1913

27 *Aleurodicus dispersus* Russell
28 *Aleurodicus floccissimus* (Martin, Hernández-Suárez & Carnero)
29 *Paraleyrodes minei* Iaccarino

APPENDIX 2. Host plants of whiteflies in the Canary Islands

- Listed here are the plants that host whiteflies in the Canary Islands. The numbers that appear in the right-hand column correspond to the whitefly taxa numbered in Appendix 1.

- Plant nomenclature was standardized using The International Plant Name Index (http://www.ipni.org) and The Plant List (2010) (http://www.theplantlist.org). For angiosperm families we follow Angiosperm Phylogeny Group III (2009) and for fern families Smith et al. (2006).

Host Plant	Whitefly species
PTERIDOPSIDA	
Aspleniaceae	
Asplenium daucifolium Lam. [*Caenopteris daucifolium* (Lam.) Desv.]	4
Dryopteridaceae	
Aspidium sp.	4
MAGNOLIOPSIDA	
Acanthaceae	
Mackaya bella Harv.	27
Adoxaceae	
Viburnum rigidum Vent.	10
Amaranthaceae	
Amaranthus cruentus L.	26
Amaranthus lividus L. [*A. blitum* ssp. *oleraceus* (L.) Costa]	26
Amaranthus sp.	20
Beta vulgaris L.	27
Anacardiaceae	
Mangifera indica L.	27, 28
Schinus terebinthifolius Raddi	27, 28
Apocynaceae	
Acokanthera oblongifolia (Hochst.) Benth. & Hook.f. ex D.B. Jacks	27
Nerium oleander L.	26, 27
Plumeria alba L.	27, 28
Plumeria rubra L. *f. acutifolia* (Poir.) Woodson	28
Araliaceae	
Polyscias guilfoylei (W. Bull) L.H.Bailey	28
Schefflera sp.	27
Asteraceae	
Ageratina adenophora (Spreng.) R.M. King & H. Rob.	18, 20, 26
Artemisia thuscula Cav.	8, 16
Bidens pilosa L.	26
Conyza bonariensis (L.) Cronquist	8
Gerbera sp.	20, 26
Helianthus annuus L.	20, 26
Lactuca palmensis Bolle	5

Lactuca sativa L.	5, 26
Lactuca serriola L.	5, 20, 26
Launaea nudicaulis (L.) Hook. f.	20
Senecio grandifolius Less.	28
Senecio petasitis (Sims) DC. [*Roldana petasitis* (Sims) H. Rob. & Brettell]	27
Sonchus oleraceus L.	5, 20, 26
Sonchus sp.	5, 26
Tagetes patula L.	20, 26
Tolpis sp.	6
Bignoniaceae	
Spathodea campanulata P. Beauv.	20, 27
Boraginaceae	
Cordia myxa L.	27
Echium giganteum L.f.	8, 11
Echium pininana Webb & Berthel.	8, 11
Echium sp.	8
Echium virescens DC.	8, 11
Wigandia caracasana Kunth.	28
***Brassicaceae* (=*Cruciferae*)**	
Brassica oleracea L.	5, 20
Brassica oleracea L. *var. italica* Plenck [*B. cretica* Lam.]	5
Crambe pritzelii Bolle	20
Crambe santosi Bramwell	6
Crambe strigosa L'Hér.	6
Hirschfeldia incana (L.) Lagr.-Foss.	20
Campanulaceae	
Canarina canariensis (L.) Vatke	6, 26
Caricaceae	
Carica papaya L.	27
Cistaceae	
Cistus monspeliensis L.	8
Cistus ochreatus C.Sm. ex Buch	8, 11
Cistus symphytifolius Lam.	8
Cistus sp.	11
Convolvulaceae	
Convolvulus canariensis L.	20, 26
Ipomoea batatas (L.) Poir.	20, 26
Combretaceae	
Terminalia catappa L.	27
Cucurbitaceae	
Cucumis melo L.	20
Cucumis sativus L.	20, 26
Cucurbita ficifolia Bouché	20, 26
Cucurbita maxima Duchesne	20, 26
Cucurbita pepo L.	20, 26
Cucurbita sp.	25
Sechium edule (Jacq.) Sw.	26

Dipsacaceae	
Pterocephalus dumetorum (Brouss. *ex* Willd.) Coult.	8
Euphorbiaceae	
Acalypha wilkesiana Müll.Arg.	27, 28
Codiaeum variegatum (L.) Rumph. ex A.Juss.	2, 3
Euphorbia atropurpurea Brouss. ex Willd.	1, 17, 26
Euphorbia balsamifera Aiton	1, 17, 26
Euphorbia berthelotii Bolle	1, 17
Euphorbia lamarckii Sweet	1, 17
Euphorbia lambii Svent.	17
Euphorbia pulcherrima Willd. *ex* Klotzsch	20, 26
Euphorbia regis-jubae Webb & Berthel.	1, 17
Ricinus communis L.	25, 26
***Fabaceae* (=*Papilionaceae*)**	
Acacia sp.	27
Bauhinia variegata L.	27, 28
Dorycnium broussonetii (Choisy *ex* Ser.) Webb	8
Dorycnium spectabile (Choisy *ex* Ser.) Webb	8
Phaseolus vulgaris L.	26
Robinia pseudoacacia L.	26
Teline microphylla (DC.) P.E.Gibbs & Dingwall	8, 13
Fagaceae	
Castanea sativa Mill.	26
Geraniaceae	
Pelargonium sp.	20, 26
Hypericaceae	
Hypericum canariense L.	8, 18
Hypericum grandifolium Choisy	18, 20
Hypericum reflexum L.f.	19
***Lamiaceae* (=*Labiatae*)**	
Bystropogon odoratissimus Bolle	8, 9
Mentha spicata L.	26
Salvia officinalis L.	26
Thymus vulgaris L.	26
Lauraceae	
Apollonias barbujana (Cav.) Bornm.	28
Laurus novocanarienis Rivas-Mart. *et al.*	8, 10
Ocotea foetens (Aiton) Benth. & Hook.f.	8, 10
Persea americana Mill.	20, 26
Persea indica (L.) Spreng.	8, 10
Lythraceae	
Punica granatum L.	20, 24, 26, 27
Malvaceae	
Abutilon grandifolium (Willd.) Sweet	26
Brachychiton discolor F.Muell.	27, 28
Gossypium sp.	20, 26
Hibiscus calyphyllus Cav.	20, 26
Hibiscus cannabinus L.	26

Hibiscus rosa-sinensis L.	20, 26, 27
Hibiscus sp.	29
Malva sp.	20, 26
Malvaviscus penduliflorus DC.	20, 28
Meliaceae	
Azadirachta indica A.Juss.	2
Melia azedarach L.	2
Moraceae	
Artocarpus altilis (Parkinson) Fosberg	28
Ficus benjamina L.	28
Ficus carica L.	5
Ficus elastica Roxb. *ex* Hornem.	27
Ficus lyrata Warb.	27
Ficus macrophylla Desf. *ex* Pers.	28
Ficus microcarpa L.f.	27, 28
Ficus religiosa L.	28
Ficus rubiginosa Desf. *ex* Vent.	27
Ficus rubiginosa var. *glabrescens* F.M. Bailey	27
Ficus sp.	27, 28
Myricaceae	
Myrica faya Aiton [*Morella faya* (Aiton) Wilbur]	27
Myrtaceae	
Eugenia uniflora L.	27
Psidium guajava L.	27, 28
Psidium sp.	27
Nyctaginaceae	
Bougainvillea spectabilis Willd.	27, 28
Bougainvillea sp.	27
Oleaceae	
Picconia excelsa (Aiton) DC.	23
Oxalidaceae	
Oxalis pes-caprae L.	20, 26
Passifloraceae	
Passiflora edulis Sims	2, 27
Pentaphylacaceae	
Visnea mocanera L.f.	8
Pittosporaceae	
Pittosporum tobira (Thunb.) W.T.Aiton	28
Plumbaginaceae	
Limonium sp.	27
Polygonaceae	
Coccoloba uvifera (L.) L.	2, 27, 28
Proteaceae	
Stenocarpus sinuatus (Loudon) Endl.	28

Rosaceae	
Bencomia caudata (Aiton) Webb & Berthel.	7, 14
Marcetella maderensis (Bornm.) Svent.	8,9
Marcetella moquiniana (Webb & Berthel.) Svent.	26
Rosa sp.	20
Rubus bollei Focke	15
Rubus ulmifolius Schott	15, 20
Rubus sp.	15
Rubiacae	
Phyllis nobla L.	8, 12
Rutaceae	
Citrus limon (L.) Burm.f.	2, 29
Citrus maxima (Burm.) Merr.	2
Citrus reticulata Blanco	1, 21
Citrus sinensis (L.) Osbeck	2, 22, 29
Citrus sp.	29
Salicaceae	
Salix canariensis C.Sm. *ex* Link	8, 12
Scrophulariaceae	
Myoporum laetum G.Forst.	27
Solanaceae	
Capsicum annuum L.	20, 26, 27
Hyoscyamus albus L.	26
Nicotiana glauca Graham	20, 26, 28
Nicotiana tabacum L.	20, 26
Solandra maxima (Sessé & Moç.) P.S.Green	27, 28
Solanum argentinum Bitter & Lillo	27
Solanum lycopersicum L.	20, 26
Solanum muricatum Aiton	20
Solanum nigrum L.	20
Solanum sp.	27
Solanum tuberosum L.	20, 26
Tropaeolaceae	
Tropaeolum sp.	26
Urticaceae	
Forsskaolea angustifolia Retz.	26
Gesnouinia arborea (L.f.) Gaudich.	8, 12
Parietaria judaica L.	26
Parietaria sp.	8
Verbenaceae	
Lantana camara L.	20, 26, 27
Vitaceae	
Vitis vinifera L.	27

LILIOPSIDA

Araceae

Monstera deliciosa Liebm.	28
Philodendron selloum K.Koch.	28

Asparagaceae

Cordyline australis (G.Forst.) Endl.	28
Cordyline fruticosa (L.) A.Chev.	28
Dracaena draco (L.) L.	27, 28
Yucca aloifolia L.	27
Yucca sp.	27

***Arecaceae* (=*Palmaceae*)**

Archontophoenix alexandrae (F.Muell.) H.Wendl. & Drude	27, 28
Archontophoenix cunninghamiana (H.Wendl.) H.Wendl. & Drude	28
Arenga pinnata (Wurmb) Merr.	28
Brahea armata S.Watson	28
Brahea brandegeei (Purpus) H.E.Moore	28
Caryota urens L.	28
Chamaedorea costaricana Oerst.	28
Chamaerops humilis L.	28
Cocos nucifera L.	3, 27, 28, 29
Dictyosperma album (Bory) Scheff.	28
Dypsis lutescens (H.Wendl) Beentje & J. Dransf.	28
Howea forsteriana (F.Muell.) Becc.	3, 27, 28
Hyophorbe verschaffeltii H.Wendl.	28
Livistona chinensis R.Br. *ex* Mart..	28
Phoenix canariensis Hort. *ex* Chabaud	27, 28
Phoenix dactylifera L.	28
Phoenix roebelinii O'Brien	28
Phoenix sp.	27
Rhapis humilis Blume	28
Rhopalostylis baueri (Hook.f.) H.Wendl. & Drude	28
Rhopalostylis sapida (Sol. *ex* G.Forst.) H.Wendl. & Drude	28
Roystonea borinquena O.F.Cook	28
Roystonea regia (Kunth) O.F.Cook	27
Syagrus romanzoffiana (Cham.) Glassman	3, 28, 29
Thrinax radiata Lodd. *ex* Schult. & Schult.f.	28
Trachycarpus fortunei (Hook.) H.Wendl.	28
Trachycarpus martianus (Wall. *ex* Mart.) H.Wendl.	28
Trachycarpus wagnerianus Hort. *ex* Becc.	28
Veitchia joannis H.Wendl.	28
Veitchia montgomeryana H.E.Moore	28
Washingtonia filifera (Linden *ex* André) H.Wendl.	27, 28
Washingtonia robusta H.Wendl.	27, 28
Washingtonia sp.	28

Costaceae

Costus megalobractea K.Schum.	28

Doryanthaceae

Doryanthes palmeri W. Hill ex Benth.	28

Heliconiaceae	
Heliconia bihai (L.) L.	28
Heliconia champneiana Griggs	28
Musaceae	
Musa acuminata Colla	27, 28
Musa textilis Née	28
Musa sp.	27, 28
***Poaceae* (=*Gramineae*)**	
Bambusa sp.	28
Strelitziaceae	
Ravenala madagascariensis Sonn.J.F.Gmel.	28
Strelitzia alba (L.f.) Skeels	27, 28
Strelitzia augusta	29
Strelitzia nicolai Regel & K.Koch	27, 28
Strelitzia sp.	28
Xanthorrhoeaceae	
Aloe arborescens Mill.	27
Zingiberaceae	
Alpinia zerumbet (Pers.) B.L.Burtt & R.M.Sm.	28
Zingiber sp.	28
Zingiber zerumbet (L.) Roscoe *ex* Sm.	28

APPENDIX 3. Additional whitefly material examined.

- Listed here is the Canary Islands whitefly material examined, *excluding* the species newly described here and forms A to H of the *Bemisia afer* complex.

Acaudaleyrodes rachipora (Singh)

Material examined: LANZAROTE: Playa Blanca, 29.xii.96 (E. Hdez.) on *Euphorbia balsamifera*, same data but: 1.i.97 (E. Hdez.) on *E. balsamifera*, 4.v.97 (E. Hdez.) on *Euphorbia regis-jubae* y *E. balsamifera*, 30.xii.97 (E. Hdez.) on *E. balsamifera*; Órzola, 4.v.97 (E. Hdez.) on *E. balsamifera*, same data but: 30.xii.97 (E. Hdez.) on *E. balsamifera*; Costa Teguise, 8.iii.97 (E. Hdez.) on *E. balsamifera*. FUERTEVINTURA: Toto, 11.iii.97 (E. Hdez.) on *E. balsamifera*. GRAN CANARIA: Moya, 22.i.98 (E. Hdez.) on *E. balsamifera*. TENERIFE: Valle Guerra, 12.vi.97 (E. Hdez.) on *Euphorbia atropurpurea*, same data but: 2.vi.97 (E. Hdez.) on *E. atropurpurea*; Playa San Juan, 7.iv.97 (E. Hdez.) on *Citrus sinensis*; Las Américas, 11.v.97 (E. Hdez.) on *E. balsamifera*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *Euphorbia lamarckii* var. *wildpretii*; Barranco Moradas, 18.v.97 (E. Hdez.) on *E. lamarckii* var. *wildpretii*; Barranco Badajoz, 1.xii.96 (E. Hdez.) on *E. lamarckii var. wildpretii*; Agua Dulce, 29.iv.97 (E. Hdez.) on *E. balsamifera*. GOMERA: San Sebastián, 14.vi.97 (E. Hdez.) on *Euphorbia berthelotii*; Barranco Santiago, 24.i.98 (E. Hdez.) on *Euphorbia berthelotii*. PALMA: Puerto Nao, 22.vi.97 (E. Hdez.) on *E. balsamifera*; Los Sauces, 21.vi.97 (E. Hdez.) on *E. lamarckii var. wildpretii*; Los Cancajos, 21.vi.97 (E. Hdez.) on *E. lamarckii var. wildpretii*; Barranco de las Angustias, 22.vi.97 (E. Hdez.) on *E. lamarckii var. wildpretii*.

Aleurothrixus floccosus (Maskell)

Material examined: LANZAROTE: Tinajo, 3.v.97 (E. Hdez.) on *Citrus sinensis*; Playa Blanca, 4.v.97 (E. Hdez.) on *Coccoloba uvifera*; Las Breñas, 10.iii.97 (E. Hdez.) on *Citrus sinensis*; Granja del Cabildo, 29.xii.94 (E. Hdez.) on *Coccoloba uvifera*; Arrecife, 29.xii.94 (E. Hdez.) on *Coccoloba uvifera.* FUERTEVENTURA: Pájara, 22.viii.95 (E. Hdez.) on *Coccoloba uvifera*, same data but: 28.xii.94 (E. Hdez.) on *Coccoloba uvifera*, *Citrus sinensis*. GRAN CANARIA: La Aldea, 12.viii.97 (E. Hdez.) on *Citrus limon*; 1 ninfa, *s.l.*, vi. 1992 (IIE, 22516) on *Azadirachta indica* (BMNH). TENERIFE: Santa Cruz, 28.x.96 (E. Hdez.) on *Passiflora edulis* y *Codiaeum variegatum*; Puerto de la Cruz, 28.iv.97 (E. Hdez.) on *Citrus limon*; Punta del Hidalgo, 20.xi.94 (E. Hdez.) on *Melia azedarach* y *Citrus sinensis*; Playa San Juan, 4.vii.97 (E. Hdez.) *Citrus limon* y *Citrus sinensis,* same data but: 7.iv.97 (E. Hdez.) on *Citrus sinensis*, 30.xi.94 (E. Hdez.) on *Citrus sinensis*; Los Realejos, 18.xi.94 (E. Hdez.) on *Citrus maxima*, *C. limon*, y *C. sinensis*; Las Galletas, 15.vi.96 (E. Hdez.) on *C. limon*; Güímar, 21.vi.96 (E. Hdez.) on *C. sinensis*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *C. limon*; Bahía del Duque, 3.ii.95 (E. Hdez.) on *C. sinensis,* same data but: 21.xi.96 (E. Hdez.) on *C. limon*. GOMERA: Valle Hermoso, 5.iii.95 (E. Hdez.) on *C. limon*; Valle Gran Rey, 5.iii.95 (E. Hdez.) on *C. sinensis*; San Sebastián, 15.vi.97 (E. Hdez.) on *C. sinensis*, same data but: 5.iii.95 (E.Hdez.) on *C. limon*; P. Santiago, 4.iii.95 (E. Hdez.) on *C. limon* y *C. sinensis*; Barranco Santiago, 14.vi.97 (E. Hdez.) on *C. limon.* PALMA: S/C de La Palma, 28.v.96 (E. Hdez.) on *C. limon*; El Paso, 22.vi.97 (E. Hdez.) on *C. sinensis*. CANARIAS *sens. lat.*: varias pupas, Canary Is., xi.1937 (E.R. Speyer) on orange (BMNH).

Aleurotrachelus atratus Hempel

Material examined: TENERIFE: Santa Cruz, 28.x.96 (E. Hdez.) on *Syagrus romanzoffiana*, *Codiaeum variegatum*, same data but: 22.v.97 (E. Hdez.) on *S. romanzoffiana*, 21.i.98 (E. Hdez.) on *S. romanzoffiana*; Punta del Hidalgo, 13.xi.98 (E. Hdez.) on *Howea forsteriana*; Taganana, xi.98 (M. Hdez.) on *Howea forsteriana*. GRAN CANARIA: Las Palmas de Gran Canaria, 14.iv.07 (E. Hdez. & C. Ramos) on *Cocos nucifera*. LA GOMERA: San Sebastián, 24.viii.97 (E. Hdez.) on *Cocos nucifera*.

Aleurotulus nephrolepidis (Quaintance)

Material examined: TENERIFE: Jardín Botánico Orotava, vii.1950 (Gómez-Menor) on helecho [fern] (MNCN); Puerto de la Cruz, Jardín Botánico, 10.xii.97 (E. Hdez.) on *Asplenium daucifolium*, same data but: 20.v.97 (E. Hdez.).

Aleyrodes proletella (Linnaeus)

Material examined: LANZAROTE: Tinajo, 4.v.97 (E. Hdez.) on *Brassica oleracea*; Femés, 3.v.97 (E. Hdez.) on *B. oleracea*; Costa Teguise, 4.v.97 (E. Hdez.) on *Sonchus oleraceus*; Arrecife, 21.iv.96 (E. Hdez.) on *B. oleracea*. FUERTEVINTURA: Vega del Río Palma, 28.xii.94 (E. Hdez.) on *B. oleracea*; same data but: 4.v.97 (E. Hdez.) on *B. oleracea*; Corralejo, 11.ii.97 (E. Hdez.) on *S. oleraceus*. GRAN CANARIA: Vecindario, 5.iv.95 (E. Hdez.) on *Sonchus sp.* TENERIFE: Puerto de la Cruz, 28.iv.97 (E. Hdez.) on *Lactuca serriola;* Puerto de la Cruz, 13.iv.1959 (O.W. Richards) *ex* leaves of *Euphorbiaceae* tree (BMNH); Pajalillos, 22.x.96 (E. Hdez.) on *B. oleracea,* same data but: 4.xii.96 (E. Hdez.); La Guancha, 25.v.95 (E. Hdez.) on *B. oleracea* var. *italica*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *L. serriola*; Buenavista, 12.vii.95 (E. Hdez.) on *B. oleracea* var. *italica,* same data but: 25.xi.96 (E. Hdez.) on *B. oleracea*; Altos de Güímar, 26.xi.94 (E. Hdez.) on *B. oleracea*; Agua Dulce, 29.iv.97 (E. Hdez.) on *L. serriola*, same data but: 21.v.97 (E. Hdez.); La Orotava, vii.1950 (Gómez-Menor) on col [*Brassica*] (MNCN); Icod el Alto, vii.1950 (Gómez-Menor) on col[*Brassica*] (MNCN); La Perdoma, vii.1950 (Gómez-Menor) on *Lactuca* (MNCN); La Matanza de Acentejo, 20.v.1997, *Lactuca serriola*. GOMERA: Vallehermoso, 4.iii.95 (E. Hdez.) on *B. oleracea*; San Sebastián, 15.vi.97 (E. Hdez.) on *L. serriola*; Hermigua, 15.vi.97 (E. Hdez.) on *B. oleracea*; Barranco Santiago, 4.iii.95 (E. Hdez.) on *B. oleracea,* same data but: 15.vi.97 (E. Hdez.) on *Lactuca sativa*. PALMA: R. de los Muchachos, 22.vi.97 (E. Hdez.) on *Lactuca palmensis*; Mirador de la Cumbrecita, 22.vi.97 (E. Hdez.) on *Ficus carica*; Los Tilos, 21.vi.97 (E. Hdez.) on *S. oleraceus*; Los Sauces, 22.vi.97 (E. Hdez.) on *B. oleracea*; Los Llanos, 22.vi.97 (E. Hdez.) on *L. serriola*; La Caldera, 22.vi.97 (E. Hdez.) on *L. palmensis*; El Paso, 22.vi.97 (E. Hdez.) on *L. serriola*, *B. oleracea.* LA PALMA: R. de los Muchachos, 22.vi.97 (E. Hdez.) on *Lactuca palmensis*; Pico de las Nieves, 22.vi.97 (E. Hdez.) on *L. palmensis*; Los Tilos, 21.vi.97 (E. Hdez.) on *Lactuca serriola*.

Bemisia afer (Priesner & Hosny) sens. lat.

Material examined: GRAN CANARIA: Los Tiles, 22.i.98 (E. Hdez.) on *Rubus ulmifolius*, *Ocotea foetens*, *Artemisia thuscula*; Barranco de Larice near Moya, 6.xii.2002 [JHM 7732] on *Rubus* sp.; Pinar near Tamadaba, 7.xii.2002 [JHM 7739] on *Cistus ochreatus*; Cruz de Tejeda, 7.xii.2002 [JHM 7738] on *Teline microphylla*. TENERIFE: Valle Guerra, 12.vi.97 (E. Hdez.) on *Pterocephalus dumetorum*, same data but: 22.v.97 on *P. dumetorum*, 6.i.98 on *A. thuscula*, 22.i.98 on *Echium sp.*, *Bencomia caudata*; Punta del Hidalgo, 1.v.98 (E. Hdez.) on *A. thuscula*; Las Mercedes, 7.vi.97 (E. Hdez.) on *Laurus novocanariensis*, same data but: 22.v.97 on *Viburnum rigidum*, *Persea indica*, 15.vii.95 on *R. ulmifolius*, 13.vii.95 on *V. rigidum;* Pico del Inglés, 22.v.97 (J.H.M.) 7071 on *Parietaria sp.* (BMNH); Laurisilva N.E. Las Mercedes, 22.v.97 (J.H.M.) on *Persea indica*, *Laurus novocanariensis* (BMNH); Güímar, 21.xii.96 (E. Hdez.) on *Convolvulus canariensis*; Erjos, 6.iv.97 (E. Hdez.) on *Rubus sp.*, *Gesnouinia arborea*, *V. rigidum*, *Echium virescens*, *Cistus symphytifolius*, *Cistus monspeliensis*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *Hypericum canariense*, *Dorycnium brousonetii*, *Conyza bonariensis*, *Bystropogon odoratissimus*, *A. thuscula*; Barranco de las Moradas, 6.iv.97 (E. Hdez) on *V. rigidum*, *G. arborea*, *Echium sp.*, *Rubus bollei*, same data but: 18.v.97 (E. Hdez.) on *V. rigidum*, *Rubus bollei*, *Echium virescens*, 8 prep. varias pupas, Barranco de las Moradas, near Icod de los Vinos, 18.v.97 (J.H.M.) on *V. rigidum*, *Laurus novocanariensis*, *Rubus sp.*, *Cistus sp.*, *G. arborea*, *Ocotea foetens* (BMNH); Barranco del Agua, 11.i.98 (E. Hdez.) on *Rubus sp.*, *P. dumetorum*; Barranco de los Cochinos, 21.i.95 (E. Hdez.) on *R. bollei*, *G. arborea*; Barranco Badajoz, 17.v.98 (E. Hdez.) on *B. odoratissimus*, *R. bollei*, *Echium sp.*, *B. caudata*, same data but: 25.i.98 on *R. ulmifolius*, *Echium sp.*, *B. caudata*, *A. thuscula*, 11.i.98 on *R. bollei*, *Echium sp.*, *B. caudata*, *A. thuscula*, 1.xii.96 on *Visnea mocanera*, *Dorycnium spectabile*, *B. caudata*. GOMERA: El Cedro, 24.i.98 (E. Hdez.) on *Laurus novocanariensis*, same data but: 15.vi.97 on *V. rigidum*, *G. arborea*, *Echium giganteum*. PALMA: Los Tilos, 21.vi.97 (E. Hdez.) on *G. arborea*, *Echium pininana*; Pista de Barlovento, 21.vi.97 (E. Hdez.) on *Rubus bollei.*

Bemisia medinae Gómez-Menor

Material examined: TENERIFE: Las Merdedes, vii.1950 (Gómez-Menor) on unidentified plant (MNCN); Laurisilva NE Las Mercedes, 22.v.97 (J.H.M.) on *Hypericum grandifolium* (BMNH); Las Mercedes, 7.vi.97 (E. Hdez.) on *H. grandifolium;* Erjos, 6.iv.97 (E. Hdez.) on *H. grandifolium*, *Hypericum canariense*; Barranco Moradas, 18.v.97 (E. Hdez.) on *H. grandifolium*, same data but: 6.iv.97 (E. Hdez.) on *H. grandifolium,* Barranco de las Moradas, near Icod de los Vinos, 18.v.97 (J.H.M.) on *H. grandifolium* (BMNH); Barranco del Agua, 11.i.98 (E. Hdez.) on *H. canariense*; Barranco de los Cochinos, 21.i.95 (E. Hdez.) on *H. grandifolium*, *Ageratina adenophora* (ICIA, BMNH); Barranco Badajoz, 25.i.98 (E. Hdez.) on *H. grandifolium*, same data but: 17.v.98 (E. Hdez.) on *H. grandifolium*. GOMERA: El Cedro, 15.vi.97 (E. Hdez.) on *H. grandifolium*.

Bemisia tabaci (Gennadius)

Material examined: LANZAROTE: Soó, 29.xii.94 (E. Hdez.) on *Ipomoea batatas*, *Cucurbita maxima*; San Bartolomé, 4.i.96 (E. Hdez.) on *I. batatas*, same data but: 29.xii.94 on *I. batatas*; Puerto del Carmen, 3.v.97 (E. Hdez.) on *Euphorbia pulcherrima*, *Hibiscus rosa-sinensis*, same data but: 9.iii.97 on *H. rosa-sinensis*, 8.iii.97 on *Nicotiana glauca*, 2.i.96 on *H. rosa-sinensis*, 29.xii.94 on *H. rosa-sinensis*; Playa Blanca, 4.v.97 (E. Hdez.) on *Sonchus oleraceus, Solanum lycopersicum*, same data but: 29.xii.96 on *Pelargonium sp.*, *N. glauca*, *H. rosa-sinensis*; Haría, 8.iii.97 (E. Hdez.) on *E. pulcherrima*, *H. rosa-sinensis*, same data but: 25.viii.95 on *E. pulcherrima*, *H. rosa-sinensis*; Granja del Cabildo, 29.xii.94 (E. Hdez.) on *S. lycopersicum, H. rosa-sinensis*, *Cucumis melo*; Femés, 9.iii.97 (E. Hdez.) on *H. rosa-sinensis*; Fariones, 25.viii.95 (E. Hdez.) on *Euphorbia millii*; Famara, 25.viii.95 (E. Hdez.) on *I. batatas*; Costa Teguise, 3.v.97 (E. Hdez.) on *S. oleraceus*, same data but: 9.iii.97 on *H. rosa-sinensis*, 31.xii.94 on *H. rosa-sinensis*; Cerro Terroso, 29.xii.94 (E. Hdez.) on *N. glauca*; Arrecife, 4.v.97 (E. Hdez.) on *S. oleraceus*, same data but: 21.iv.96 on *Solanum muricatum*, 21.iv.96 on *Brassica oleracea*, 25.ii.95 on *E. pulcherrima*, 30.xii.94 on *E. pulcherrima*. FUERTEVENTURA: Vega del Río Palma, 28.xii.94 (E. Hdez.) on *Solanum tuberosum*; Puerto del Rosario, 23.viii.95 (E. Hdez.) on *H. rosa-sinensis*, 28.xii.94; Pájara, 5.v.97 (E. Hdez.) on *H. rosa-sinensis*; same data but: 10.iii.97 on *H. rosa-sinensis*, 18.vi.95 on *E. pulcherrima*, 28.xii.94 on *Rosa sp.*, *E. pulcherrima*; Nuevo Horizonte, 5.v.97 (E. Hdez.) on *S. oleraceus*; La Oliva, 28.xii.94 (E. Hdez.) on *H. rosa-sinensis*; La Lajita, 10.ii.97 (E. Hdez.) on *Launaea nudicaulis*; Gran Tarajal, 11.iii.97 (E. Hdez.) on *N. glauca*, same data but: 9.iii.97 on *N. glauca*, *S. lycopersicum*, *Cucurbita pepo*; Corralejo, 5.v.97 (E. Hdez.) on *Lantana camara*, *H. rosa-sinensis*, same data but: 9.iii.97 on *S. oleraceus*, 28.xii.94 on *H. rosa-sinensis*; Cañada del Río, 5.v.97 (E. Hdez.) on *N. glauca*, same data but: 11.iii.97 on *N. glauca*, 3.i.96 on *N. glauca*, 22.viii.95 on *E. pulcherrima*, *H. rosa-sinensis*; Ajuí, 28.xii.94 (E. Hdez.) on *S. lycopersicum*, *Cucurbita ficifolia*. GRAN CANARIA: Vecindario, 12.viii.97 (E. Hdez.) on *Capsicum annuum*; San Nicolás, 4.i.95 (E. Hdez.) on *S. lycopersicum*; San Agustín, 4.i.96 (E. Hdez.) on *H. rosa-sinensis*; Mogán, 12.viii.97 (E. Hdez.) on *E. pulcherrima*; Las Palmas, 12.viii.97 (E. Hdez.) on *E. pulcherrima*; La Aldea, 12.viii.97 (E. Hdez.) on *E. pulcherrima*; Barranco Azuaje, 22.i.98 (E. Hdez.) on *Crambe pritzelii*; Arucas, 22.i.98 (E. Hdez.) on *E. pulcherrima*. TENERIFE: Valle Guerra, 23.i.95 (E. Hdez.) on *Nicotiana tabacum*, same data but: 30.iv.97 (E. Hdez.) on *S. oleraceus*, *Hirschfeldia incana*, 16.iii.97 (E. Hdez.) on *E. pulcherrima*, 20.ii.95 (E. Hdez.) on *Rosa sp.*, 11.xi.94 (E. Hdez.) on *Rosa sp.*; Santa Cruz, 23.iv.97 (E. Hdez.) on *E. pulcherrima*, *H. rosa-sinensis,* same data but: 6.xii.94 (E. Hdez.) on *H. rosa-sinensis*; Santa Cruz vii.1950 (Gómez-Menor) (MNCN); Puerto de la Cruz, 10.xii.97 (E. Hdez.) on *Spathodea campanulata*, *E. pulcherrima*, *Malvaviscus penduliflorus*, same data but: 20.v.97 (E. Hdez.) on *Hibiscus calyphyllus*, 28.iv.97 (E. Hdez.) on *Pelargonium sp.*, *Helianthus annuus*; Punta del Hidalgo, 20.xi.94 (E. Hdez.) on *Persea americana*; Pajalillos, 4.xii.96 (E. Hdez.) on *B. oleracea*, same data but: 22.x.96 (E. Hdez.) on *B. oleracea*; Playa San Juan, 7.iv.97 (E. Hdez.) on *Punica granatum*, *S. lycopersicum*; Los Realejos, 18.xi.94 (E. Hdez.) on *Oxalis pes-caprae*; Los Gigantes, 5.xii.94 (E. Hdez.) on *E. pulcherrima*; Las Mercedes, 7.vi.97 (E. Hdez.) on *Hypericum grandifolium, Convolvulus canariensis*, same data but: 12.v.97 (E. Hdez.) on *C. canariensis*, 21.vii.96 (E. Hdez.) on *C. canariensis*, 3.ii.95 (E. Hdez.) on *C. canariensis*, 4.xii.94 (E. Hdez.) on *C. canariensis*, 1.xi.94 (E. Hdez.) on *Rubus ulmifolius*, *C. canariensis*; Las Galletas, 29.iv.97 (E. Hdez.) on *E. pulcherrima*, *N. glauca*, same data but: 20.iii.97 (E. Hdez.) on *E. pulcherrima*, 12.vii.95 (E. Hdez.) on *E. pulcherrima*, 15.ii.95 (E. Hdez.) on *E. pulcherrima*, *S. lycopersicum*, 2.ii.95 (E. Hdez.) on *E. pulcherrima*; La Orotava, vii.1950 (Gómez-Menor) on *E. pulcherrima* (MNCN); La Laguna, 16.xi.94 (E. Hdez.) on *E. pulcherrima*, same data but: 4.xi.94 (E. Hdez.) on *Lantana camara*, 1.xi.94 (E. Hdez.) on *E. pulcherrima*, 23.x.94 (E. Hdez.) on *L. camara*; La Barranquera, 27.ii.97 (E. Hdez.) on *Gerbera sp.*, *Cucurbita ficifolia*; Güímar, 5.iii.97 (E. Hdez.) on *Capsicum annuum*, same data but: 9.ii.97 (E. Hdez.) on *E. pulcherrima*, 1.i.97 (E. Hdez.) on *S. lycopersicum*, *C. annuum*, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, *H. rosa-sinensis*, *Gerbera sp.*, 20.v.96 (E. Hdez.) on *C. annuum*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *Ageratina adenophora*; Buenavista, 12.vii.95 (E. Hdez.) on *I. batatas*, *Cucumis sativus*; Barranco Badajoz, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, *C. canariensis*; Bahía del Duque, 4.viii.97 (E. Hdez.) on *L. camara*, *E. pulcherrima*; Altos de Güímar, 26.xi.94 (E. Hdez.) on *E. pulcherrima*; Agua Dulce, 21.v.97 (E. Hdez.) on *Lactuca serriola*, same data but: 29.iv.97 on *N. glauca*, *L. serriola*, 18.ii.97 on *E. pulcherrima*, *N. glauca*, *H. rosa-sinensis*, 12.vii.95 on *H. rosa-sinensis*, 3.iii.95 on *H. rosa-sinensis*, 4.ii.95 on *N. glauca*, 5.xii.94 on *N. glauca, Malva sp.*, *H. rosa-sinensis*, 3.xi.94 on *N. glauca*, *H. rosa-sinensis*, 19.x.94 on *E. pulcherrima*, *Malva sp.*, *H. rosa-sinensis*. GOMERA: Vallehermoso, 4.iii.95 (E. Hdez.) on *B. oleracea*; Valle Gran Rey, 5.iii.95 (E. Hdez.) on *I. batatas*; Playa Santiago, 4.iii.95 (E. Hdez.) on *H. rosa-sinensis*; Jardín Tecina, 15.vi.97 (E. Hdez.) on *E. pulcherrima*, *L. camara*, same data but: 5.iii.95 on L. *camara, H. rosa-sinensis*, *Gossypium sp.*, 4.iii.95 on *E. pulcherrima*. HIERRO: Tigaday, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, *H. rosa-sinensis*; Tamaduste, 3.viii.95 (E. Hdez.) on *H. rosa-sinensis*; Sabinosa, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, *H. annuus*, same data but: 2.viii.96 on *Tagetes patula*, *E. pulcherrima*, *Amaranthus sp.*; Pozo de la Salud, 2.viii.95 (E. Hdez.) on *H. annuus*; Los Llanillos, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, same data but: 2.viii.95 on *E. pulcherrima*; Frontera, 3.viii.95 (E. Hdez.) on *E. pulcherrima*, same data but: 2.viii.95 on *Solanum nigrum*, *N. glauca*; Road Mocanal, 2.viii.96 (E. Hdez.) on *H. annuus, E. pulcherrima*. PALMA: Tazacorte, 5.vii.98 (E. Hdez.) on *N. tabacum*, same data but: 22.vi.97 on *Cucurbita maxima*; Santa Lucía, 4.vii.98 (E. Hdez.) on *E. pulcherrima*; Puerto Nao, 22.vi.97 (E. Hdez.) on *E. pulcherrima*; Los Sauces, 18.vii.95 (E. Hdez.) on *I. batatas*; Los Cancajos, 21.vi.97 (E. Hdez.) on *E. pulcherrima*, same data but: 4.v.96 *E. pulcherrima*; La Costa, 22.vi.97

(E. Hdez.) on *E. pulcherrima*, *S. lycopersicum*; El Paso, 22.vi.97 (E. Hdez.) on *L. serriola*; road Tazacorte, 22.vi.97 (E. Hdez.) on *E. pulcherrima*, *N. glauca, S. lycopersicum*; Charco Verde , 22.vi.97 (E. Hdez.) on *N. glauca*.

Dialeurodes citri (Ashmead)

Material examined: GRAN CANARIA: Arucas, 12.iv.07 (E. Hdez.) on *Citrus sinensis*.

Parabemisia myricae (Kuwana)

Material examined: TENERIFE: Valle Guerra, 16.ix.97 (A. González) on *Citrus sinensis.*

Siphoninus finitimus Silvestri

Material examined: TENERIFE: Las Mercedes, 1.xi.97 (E. Hdez.) on *Picconia excelsa*, same data but: 22.v.97 on *P. excelsa*, 13.vii.95 on *P. excelsa.* LA GOMERA: Chipude, 14.vi.97 (E. Hdez.) on *P. excelsa*; Barranco Santiago, 14.vi.97 (E. Hdez.) on *P. excelsa.*

Siphoninus phillyreae (Haliday)

Material examined: LANZAROTE: Haría, 25.viii.95 (E. Hdez.) on *Punica granatum*. FUERTEVENTURA: Vega del Río Palma, 28.xii.94 (E. Hdez.) on *P. granatum*; Pájara, 22.viii.95 (E. Hdez.) on *P. granatum*; Betancuria, 28.xii.94 (E. Hdez.) on *P. granatum.* TENERIFE: Bahía del Duque, 21.xi.96 (E. Hdez.) on *Punica granatum.* Other references: FUERTEVENTURA: Puerto del Rosario (E. Hdez); Esquinzo, Morrojable (Peña, 1994). GRAN CANARIA: Los Moriscos, Barranco Cernícalos, La Aldea (Peña, 1994).

Trialeurodes ricini (Misra)

Material examined: TENERIFE: Punta del Hidalgo, 28.ii.97 (E. Hdez.) on *Ricinus communis*; Santa Cruz, x.97 (E. Hdez.) on *R. communis*; Taganana, 19.x.98 (E Hdez.) on *Ricinus communis.* GOMERA: Valle Gran Rey, 5.iii.95 (E. Hdez.) on *R. communis*; Playa Santiago, 4.iii.95 (E. Hdez.) on *R. communis*.

Trialeurodes vaporariorum (Westwood)

Material examined: LANZAROTE: Puerto del Carmen, 8.iii.97 (E. Hdez.) on *Nicotiana glauca*; Haría, 25.viii.95 (E. Hdez.) on *N. glauca*; Granja del Cabildo, 29.xii.94 (E. Hdez.) on *Lantana camara*; Costa Teguise, 3.v.97 (E. Hdez.) on *Sonchus oleraceus*; Arrecife, 25.ii.95 (E. Hdez.) on *E. pulcherrima*. FUERTEVENTURA: Nuevo Horizonte, 5.v.97 (E. Hdez.) on *S. oleraceus*; Gran Tarajal, 11.iii.97 (E. Hdez.) on *N. glauca*, same data but: 9.iii.97 on *N. glauca*, *S. lycopersicum*, *Cucurbita pepo*; Corralejo, 5.v.97 (E. Hdez.) on *Lantana camara*, *Hibiscus rosa-sinensis*, same data but: 11.iii.97 on *S. oleraceus*, 9.iii.97 on *S. oleraceus*; Cañada del Río, 5.v.97 (E. Hdez.) on *N. glauca*, same data but: 11.iii.97 on *N. glauca*, 3.i.96 on *N. glauca*. GRAN CANARIA: Vecindario, 18.iii.98 (E. Hdez.) on *Pelargonium sp.*, *N. glauca*, same data but: 12.viii.97 on *Capsicum annuum*, 5.iv.95 on *Sonchus sp.*, *Parietaria judaica*, *S. lycopersicum*; Teror, 22.i.98 (E. Hdez.) on *Robinia speudoacacia*; Telde, 11.ii.96 (E. Hdez.) on *N. glauca*; San Nicolás, 4.i.95 (E. Hdez.) on *S. lycopersicum*; Moya, 22.i.98 (E. Hdez.) on *E. pulcherrima*; Mogán, 12.viii.97 (E. Hdez.) on *E. pulcherrima*; La Aldea, 12.viii.97 (E. Hdez.) on *E. pulcherrima*; Barranco de Guayadeque, 4.i.96 (E. Hdez.) on *N. glauca*; Arucas, 22.i.98 (E. Hdez.) on *Ricinus communis*; Arinaga, 4.i.96 (E. Hdez.) on *N. glauca*. TENERIFE: La Perdoma, vii.1950 (Gómez-Menor) on tomate y calabaza (MNCN); La Orotava, vii.1950 (Gómez-Menor) on *Tropaeolum*, tabaco, y *Passiflora* (MNCN); Valle Guerra, 23.i.95 (E. Hdez.) on *N. tabacum*; same data but: 30.iv.97 on *S. oleraceus,* 12.vi.97 on *Euphorbia atropurpurea*, 22.v.97 on *E. atropurpurea*; Puerto de la Cruz, 20.v.97 (E. Hdez.) on *Hibiscus calyphyllus*, *Helianthus annuus*, same data but: 28.iv.97 on *S. oleraceus*, *Pelargonium sp.*, *Lactuca serriola*, *Helianthus annuus*; Punta del Hidalgo, 28.ii.97 (E. Hdez.) on *Hyoscyamus albus*, same data but: 20.xi.94 on *Persea americana*, *N. glauca*, *Euphorbia balsamifera*, *Cucurbita pepo*, 6.xi.94 on *N. glauca*; Playa San Juan, 7.iv.97 (E. Hdez.) on *Punica granatum*; Los Realejos, 18.xi.94 (E. Hdez.) on *P. pulcherrima*, *Oxalis pes-crapae*, *L. camara*, *Bidins pilosa*; Las Mercedes, 1.xi.94 (E. Hdez.) on *Ageratina adenophora*; Las Galletas, 29.iv.97 (E. Hdez.) on *E. pulcherrima*, *N. glauca*, same data but: 20.iii.97 on *P. pulcherrima*,

2.ii.95 on *E. pulcherrima*, *Solanum lycopersicum*; Las Eras, 23.xi.94 (E. Hdez.) on *N. glauca*; La Laguna, 21.i.97 (E. Hdez.) on *E. pulcherrima*, same data but: 16.xi.94 on *E. pulcherrima*, 4.xi.94 on *Lantana camara*, 1.xi.94 on *E. pulcherrima*, 23.x.94 on *L. camara*, *Sechium edule*; La Barranquera, 27.ii.97 (E. Hdez.) on *S. lycopersicum*, *Gerbera sp.*; Icod, 29.vi.97 (E. Hdez.) on *L. serriola*; Güímar, 1.i.97 (E. Hdez.) on *S. lycopersicum*, *A. adenophora*; Cuevas Negras, 29.vi.97 (E. Hdez.) on *Marcetella moquiniana*; Buenavista, 12.vii.95 (E. Hdez.) on *Ipomoea batatas*, *Cucumis sativus*; Barranco de los Cochinos, 2.iii.95 (E. Hdez.) on *Convolvulus canariensis*, *A. adenophora*, same data but: 21.i.95 on *A. adenophora*; Barranco Badajoz, 25.i.98 (E. Hdez.) on *Canarina canariensis*, same data but: 11.i.98 on *A. adenophora*, 1.xii.96 on *A. adenophora, Castanea sativa*; Bahía del Duque, 4.viii.97 (E. Hdez.) on *L. camara*, same data but: 21.xi.96 on *E. pulcherrima*; Arico, 23.xi.94 (E. Hdez.) on *S. lycopersicum*; Altos de Güímar, 26.xi.94 (E. Hdez.) on *E. pulcherrima*; Agua Dulce, 21.v.97 (E. Hdez.) on *L. serriola*, same data but: 29.iv.97 on *N. glauca*, *L. serriola*, 18.ii.97 on *N. glauca*, 15.viii.95 on *N. glauca*, 12.vii.95 on *E. pulcherrima*, 3.iii.95 on *N. glauca*, 4.ii.95 on *N. glauca*, 5.xii.94 on *N. glauca*, *Malva sp.*, 3.xi.94 on *N. glauca, Malva sp.*, 19.x.94 on *Thymus vulgaris*, *Salvia officinalis*, *E. pulcherrima, N. glauca*, *Malva sp.*, *Hibiscus cannabinus*, *Forsskaolea angustifolia*, *Amaranthus lividus*, *Mentha spicata*; Adeje, 30.xi.94 (E. Hdez.) on *S. lycopersicum.* GOMERA: Vallehermoso, 11.ix.96 (E. Hdez.) on *E. pulcherrima*, same data but: 5.iii.95 on *H. rosa-sinensis*; Valle Gran Rey, 5.iii.95 (E. Hdez.) on *Phaseolus vulgaris*, *Cucurbita pepo*; Playa Santiago, 4.iii.95 (E. Hdez.) on *E. pulcherrima*, *H. rosa-sinensis*, *Cucurbita ficifolia*; Langrero, 4.iii.95 (E. Hdez.) on *Cucurbita maxima*; Jardín Tecina, 15.vi.97 (E. Hdez.) on *L. camara*; Hermigua, 15.vi.97 (E. Hdez.) on *C. ficifolia*, *Abutilon grandifolium*, same data but: 4.iii.95 on *C. ficifolia*, *A. grandifolium*; El Cedro, 15.vi.97 (E. Hdez.) on *S. oleraceus*, same data but: 4.iii.95 on *A. adenophora*; Barranco Santiago, 24.i.98 (E. Hdez.) on *N. glauca*, *Euphorbia sp.*, same data but: 15.vi.97 on *Lactuca sativa.* HIERRO: Valverde, 1.xii.96 (E. Hdez.) on *Euphorbia pulcherrima*; Tamaduste, 3.viii.95 (E. Hdez.) on *H. rosa-sinensis*, *N. glauca*; Sabinosa , 1.xii.96 (E. Hdez.) on *E. pulcherrima*, *Nerium oleander*, *H. annuus*, same data but: 2.viii.96 on *Tagetes patula*, *E. pulcherrima*, *Amaranthus sp.*, 5.viii.95 on *C. ficifolia*; Pozo de la Salud, 2.viii.96 (E. Hdez.) on *H. annuus*, *Amaranthus cruentus*; Los Llanillos, 1.xii.96 (E. Hdez.) on *E. pulcherrima*, same data but: 2.viii.95 on *E. pulcherrima*, *L. camara*; Gorreta, 3.viii.96 (E. Hdez.) on *N. tabacum*, *Gossypium sp.*; Frontera, 2.viii.96 (E. Hdez.) on *N. glauca*; Road Mocanal, 2.viii.96 (E. Hdez.) on *H. annuus*. PALMA: Tazacorte, 5.vii.98 (E. Hdez.) on *N. tabacum*; Santa Lucía, 4.vii.98 (E. Hdez.) on *E. pulcherrima*; Santa Cruz de La Palma, 4.vii.98 (E. Hdez.) on *C. pepo*; Los Tilos, 21.vi.97 (E. Hdez.) on *L. serriola*; Los Sauces, 22.vi.97 (E. Hdez.) on *C. maxima*; Los Nacientes, 21.vi.97 (E. Hdez.) on *S. oleraceus*; Los Llanos, 22.vi.97 (E. Hdez.) on *N. glauca*, *L. serriola*, same data but: 4.v.96 on *Solanum tuberosum*, 11.ii.96 on *N. glauca*; Los Cancajos, 21.vi.97 (E. Hdez.) on *P. pulcherrima*; La Costa, 22.vi.97 (E. Hdez.) on *S. lycopersicum*; El Roque, 22.vi.97 (E. Hdez.) on *S. lycopersicum*, *C. ficifolia*; El Paso, 22.vi.97 (E. Hdez.) on *S. tuberosum*, *L. serriola*; Road Tazacorte, 22.vi.97 (E. Hdez.) on *N. glauca*, *L. esculentum*; Charco Verde, 22.vi.97 (E. Hdez.) on *N. glauca*; Barlovento, 22.vi.97 (E. Hdez.) on *S. tuberosum.*

Aleurodicus dispersus Russell

Material examined: LANZAROTE: Puerto del Carmen, 25.viii.95 (E. Hdez.) on *Yucca aloifolia*, *Schinus terebinthifolius*, *Nerium oleander*, *Musa sp.*, *Lantana camara*, *Hibiscus rosa-sinensis*, *Ficus lyrata, Ficus elastica*, *Dracaena draco*, *Coccoloba uvifera*, *Bougainvillea spectabilis*, same data but: 29.xii.94 on *Ficus sp.*, *Coccoloba uvifera*; Playa Blanca, 4.v.97 (E. Hdez.) on *Psidium guajava*, *Mangifera indica*; Fariones, 29.xii.97 (E. Hdez.) on *Schinus terebinthifolius*, *Phoenix canariensis*; *Myoporum laetum*, *Cocos nucifera*, same data but: 10.iii.97 on *Washingtonia filifera,* 10.iii.97 on *Schinus terebinthifolius*, *Hibiscus rosa-sinensis*, *Cocos nucifera*, 1.i.97 on *Schinus terebinthifolius*, 10.i.96 on *Schinus terebinthifolius*; Costa Teguise, 3.v.97 (E. Hdez.) on *Phoenix sp.*, same data but: 10.iii.97 on *Solandra maxima*, *Schinus terebinthifolius*; Arrecife, 29.xii.97 (E. Hdez.) on *Psidium guajava*, same data but: 31.xii.94 on *Nerium oleander*, *Hibiscus rosa-sinensis, Ficus rubiginosa*, *Ficus microcarpa*, *Acokanthera oblongifolia.* FUERTEVENTURA: Corralejo, 9.iii.97 (E. Hdez.) on *Strelitzia nicolai*, *Psidium guajava*, *Limonium sp.*, *Ficus rubiginosa*, *Cocos nucifera*, same data but: 22.iv.96 on *Strelitzia nicolai, Howea forsteriana*, 8.i.96 on *Ficus sp.*, 3.i.96 on *Strelitzia nicolai*, 22.viii.95 on *Yucca sp., Washingtonia robusta*, *Strelitzia nicolai*, *Solandra maxima*, *Schinus terebinthifolius*, *Plumeria alba, Phoenix canariensis*, *Nerium oleander*, *Musa acuminata*, *Hibiscus rosa-sinensis*, *Ficus microcarpa*, *Ficus lyrata*, *Ficus rubiginosa* var. *glabrescens, Cocos nucifera*, *Coccoloba uvifera*, *Bougainvillea sp., Aloe arborescens*, *Acalypha wilkesiana*, 28.xii.94 on *Coccoloba uvifera*; Cañada del Río, 3.i.96 (E. Hdez.) on *Washingtonia filifera*. GRAN CANARIA: San Agustín, 11.ii.96 (E. Hdez.) on *Coccoloba uvifera*, same data but: 4.i.96 on *Solandra maxima*, *Hibiscus rosa-sinensis*, 11.ii.96 on *Schinus terebinthifolius*, *Coccoloba uvifera*; Playa del Ingles, 11.ii.96 (E. Hdez.) on *Schinus terebinthifolius*; Las Palmas, 13.viii.97 (E. Hdez.) on *Washingtonia filifera*, *Roystonea regia, Ficus microcarpa, Cocos nucifera,* same data but: 15.xii.96 on *Coccoloba uvifera.* TENERIFE: Santa Cruz, 20.v.97 (E. Hdez.) on *Brachychiton discolor*, *Terminalia catappa*, same data but: 23.iii.98 in *Bauhinia variegata*, 12.xii.97 on *Ficus sp.*, 1.xii.97 on *Bracychiton discolor*, 28.x.96 on *Solandra maxima, Schefflera sp.*, *Plumeria alba*, *Mangifera indica*, *Carica papaya*, 27.xi.97 on *Spathodea campanulata*; Puerto Cruz, 30.x.96 (E. Hdez.) on *Strelitzia alba*, *Acacia sp.*, same data but: 23.iii.98 on *Coccoloba uvifera*, 10.xii.97 on *Spathodea campanulata*, *Solanum sp.*, *Solandra maxima*, *Psidium guajava*, *Passiflora edulis*, *Myrica faya*, *Mackaya*

bella, Bauhinia variegata, 20.v.97 on *Terminalia catappa*, *Solanum sp.*, *Solanum argentinum*, *Solandra maxima*, *Sinecio petasitis*, *Schinus terebinthifolius*, *Psidium sp.*, *Myrica faya*, *Mackaya bella*, *Eugenia uniflora*, *Cordia myxa*, *Archontophoenix alexandrae*, *Musa acuminata*, 21.xi.96 on *Musa sp.*; Punta del Hidalgo, 25.v.96 (E. Hdez.) on *Howea forsteriana*; Playa San Juan, 7.iv.97 (E. Hdez.) on *Musa acuminata*; Los Gigantes, 8.xii.96 (E. Hdez.) on *Solandra maxima*, *Coccoloba uvifera*; Güímar, 9.ii.97 (E. Hdez.) on *Strelitzia nicolai*; Bahía del Duque, 21.xi.96 (E. Hdez.) on *Schinus terebinthifolius*, *Punica granatum*, *Cocos nucifera*, *Acacia sp.*; GOMERA: San Sebastián, 24.viii.97 (E. Hdez.) on *Cocos nucifera*, same data but: 24.xi.96 on *Vitis vinifera*, *Nerium oleander*, *Howea forsteriana*, *Hibiscus rosa-sinensis*, *Ficus microcarpa*, *Capsicum annuum*, 23.xi.96 on *Vitis vinifera, Nerium oleander, Howea forsteriana, Hibiscus rosa-sinensis*, *Ficus microcarpa*, *Capsicum annuum, Beta vulgaris.*

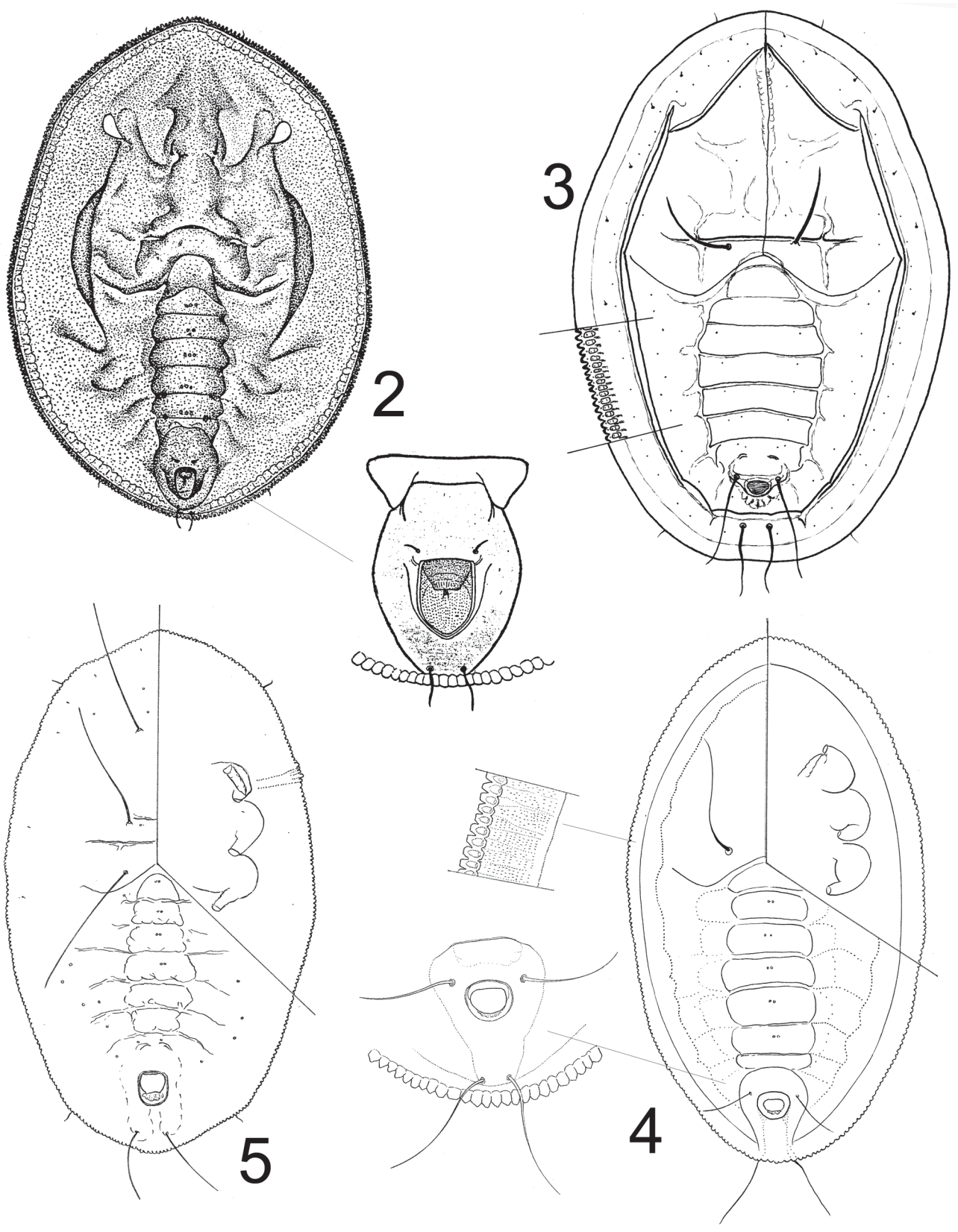
Aleurodicus floccissimus (Martin *et al.*)

Material examined: TENERIFE: Holotype, 1 prep. pupa, Santa Cruz de Tenerife, 26.v.96 (E. Hdez.) on *Ficus sp.* (BMNH); Valle Guerra, 10.xi.97 (E. Hdez.) on *Musa acuminata*, same data but: 9.ix.97 on *M. acuminata*; Tembel, 20.v.97 (E. Hdez.) on *Heliconia humilis*; Santa Cruz, 20.v.97 (E. Hdez.) on *Ravenala madagascariensis*, *Monstera deliciosa*, *Brachychiton discolor*, same data but: 23.iii.98 on *Bauhinia variegata*, 12.xii.97 on *Ficus sp.*, 31.x.96 on *Stenocarpus sinuatus*, *Polyscias guilfoylei*, *Hyophorbe verschaffeltii*, *Malvaviscus penduliflorus*, *Brahea armata*, 28.x.96 on *Washingtonia robusta*, *Washingtonia filifera*, *Strelitzia nicolai*, *Plumeria alba*, *Phoenix roebelinii*, *Phoenix dactylifera*, *Phoenix canariensis*, *Mangifera indica*, *Livistona chinensis*, *Ficus macrophylla*, *Ficus benjamina*, *Dypsis lutescens*, *Chamaerops humilis*, *Bougainvillea spectabilis*, *Syagrus romanzoffiana*; 28.x.96 on *Archontophoenix cunninghamiana*, *Acalypha wilkesiana*, 24.vii.96 on *P. roebelinii*, *Howea forsteriana*, *Dypsis lutescens*, *S. romanzoffiana*; San Juan de La Rambla, 5.xii.94 (E. Hdez.) on *Washingtonia filifera*, *M. acuminata*, *Ficus microcarpa*, same data but: 7.i.97 on *F. benjamina*; Puerto Cruz, 30.x.96 (E. Hdez.) on *Strelitzia alba*, same data but: 10.xii.97 on *Zingiber sp.*, *Solandra maxima*, *Schinus terebinthifolius*, *Psidium guajava*, *Mangifera indica*, *Ficus religiosa*, *Costus megalobractea*, 20.v.97 on *Zingiber zerumbet*, *Wigandia caracasana*, *Veitchia montgomeryana*, *Veitchia joannis*, *Trachycarpus wagnerianus*, *Trachycarpus martianus*, *Trachycarpus fortunei*, *Thrinax radiata*, *Strelitzia sp.*, *Strelitzia alba*, *Solandra maxima*, *Senecio grandifolius*, *Roystonea borinquena*, *Rhopalostylis sapida*, *Rhopalostylis baueri*, *Rhapis humilis*, *Plumeria rubra* f. *acutifolia*, *Pittosporum tobira*, *Philodendron selloum*, *Musa textilis*, *Musa sp.*, *Mangifera indica*, *Livistona chinensis*, *Heliconia champneiana*, *Heliconia bihai*, *Ficus religiosa*, *Dypsis lutescens*, *Doryanthes palmeri*, *Dictyosperma album*, *C. megalobractea*, *Cordyline fruticosa*, *Cordyline australis*, *Coccoloba uvifera*, *Chamaerops humilis*, *Chamaedorea costaricana*, *Caryota urens*, *Brahea brandegeei*, *Bambusa sp.*, *Artocarpus altilis*, *Arenga pinnata*, *S. romanzoffiana*, *Archontophoenix cunninghamiana*, *Archontophoenix alexandrae, Apollonias barbujana*, *Alpinia zerumbet*, *Acalypha wilkesiana*, 28.iv.97 on *M. acuminata*, *Dracaena draco*, 21.xi.96 on *Musa sp.*; Playa San Juan, 7.iv.97 (E. Hdez.) on *M. acuminata*, same data but: 8.iii.97 on *M. acuminata*, 30.xi.94 on *Nicotiana glauca*, *Musa acuminata*, *Ficus microcarpa*; Los Gigantes, 8.xii.96 (E. Hdez.) on *Washingtonia filifera*, *Phoenix canariensis*, same data but: 5.xii.94 (E. Hdez.) on *Coccoloba uvifera*, *Washingtonia sp.*; Bahía del Duque, 21.xi.96 (E. Hdez.) on *Strelitzia nicolai*, *S. terebinthifolius*, *F. benjamina*, *Cocos nucifera*; Adeje, 7.iv.97 (E. Hdez.) on *M. acuminata*, same data but: 23.xi.94 on *M. acuminata*.

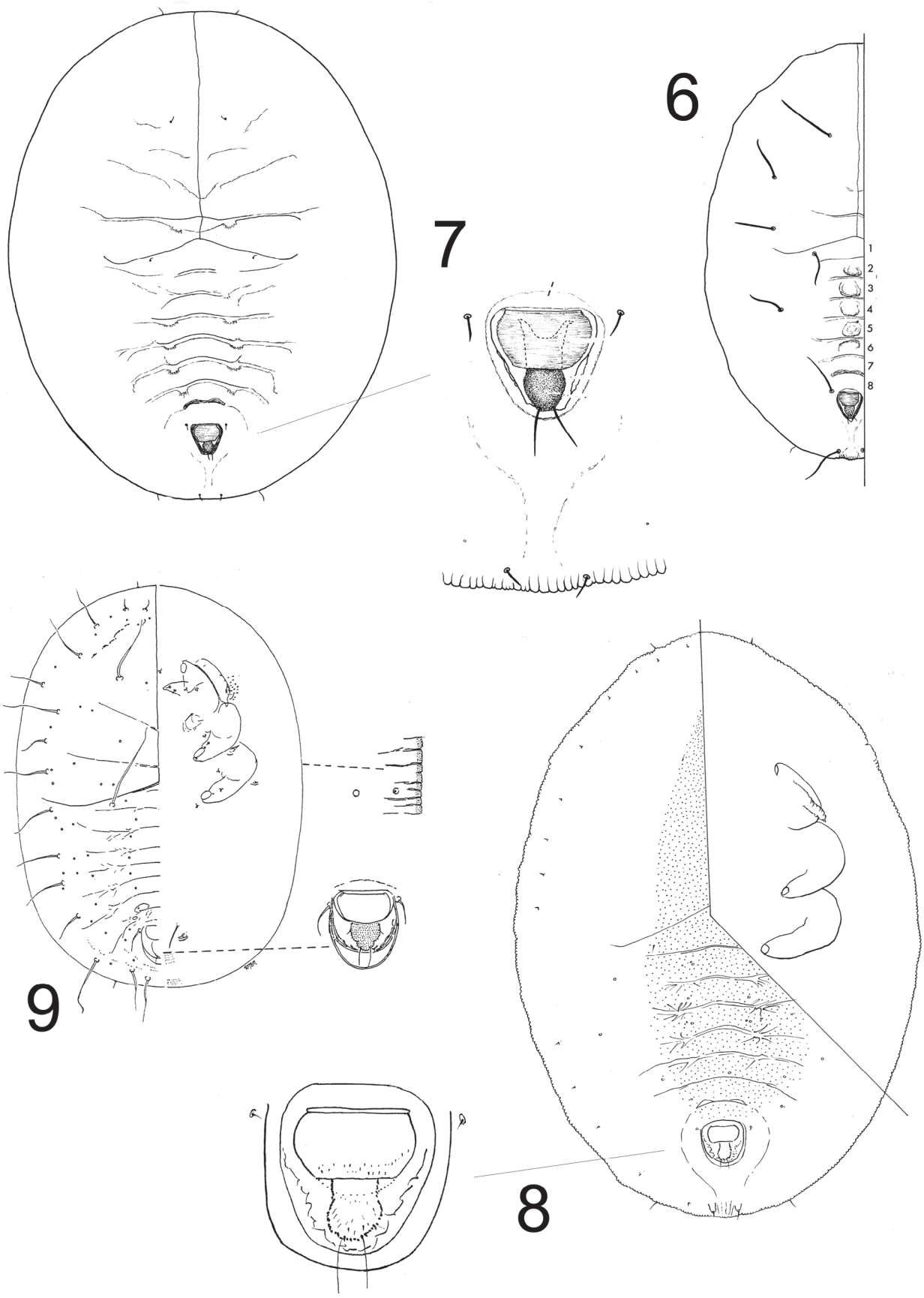
Paraleyrodes minei Iaccarino

Material examined: TENERIFE: Santa Cruz de Tenerife, 05.v.08 (E. Hdez. & R. Rizza.) on *Cocos nucifera*; GRAN CANARIA: Arucas, 13.iv.07 (E. Hdez. & C. Ramos) on *Citrus* sp.; Puerto de Mogán, 13.iv.07 (E. Hdez. & C. Ramos) on *Strelitzia augusta*; San Bartolomé, 14.iv.07 (E. Hdez. & C. Ramos) on *Cocos nucifera*. LA PALMA: Tazacorte, 06.x.08 (E. Hdez. & C. Ramos) on *Cocos nucifera*. LA GOMERA: San Sebastián, 04.i.07 (E. Hdez. & C. Ramos) on *Citrus sinensis*; Valle Hermoso, 03.i.07 (E. Hdez. & C. Ramos) on *Citrus limon*.

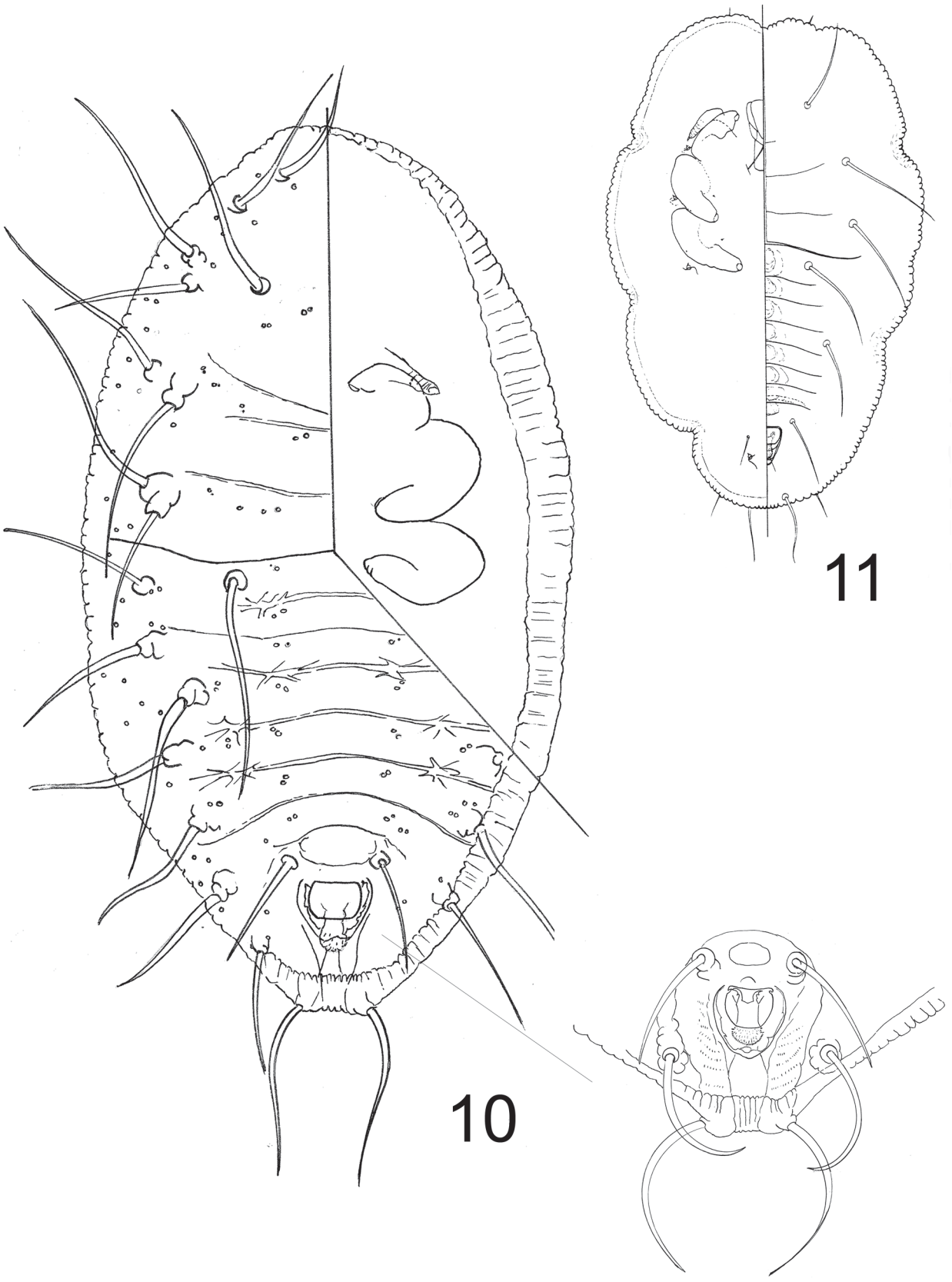
Illustrations:



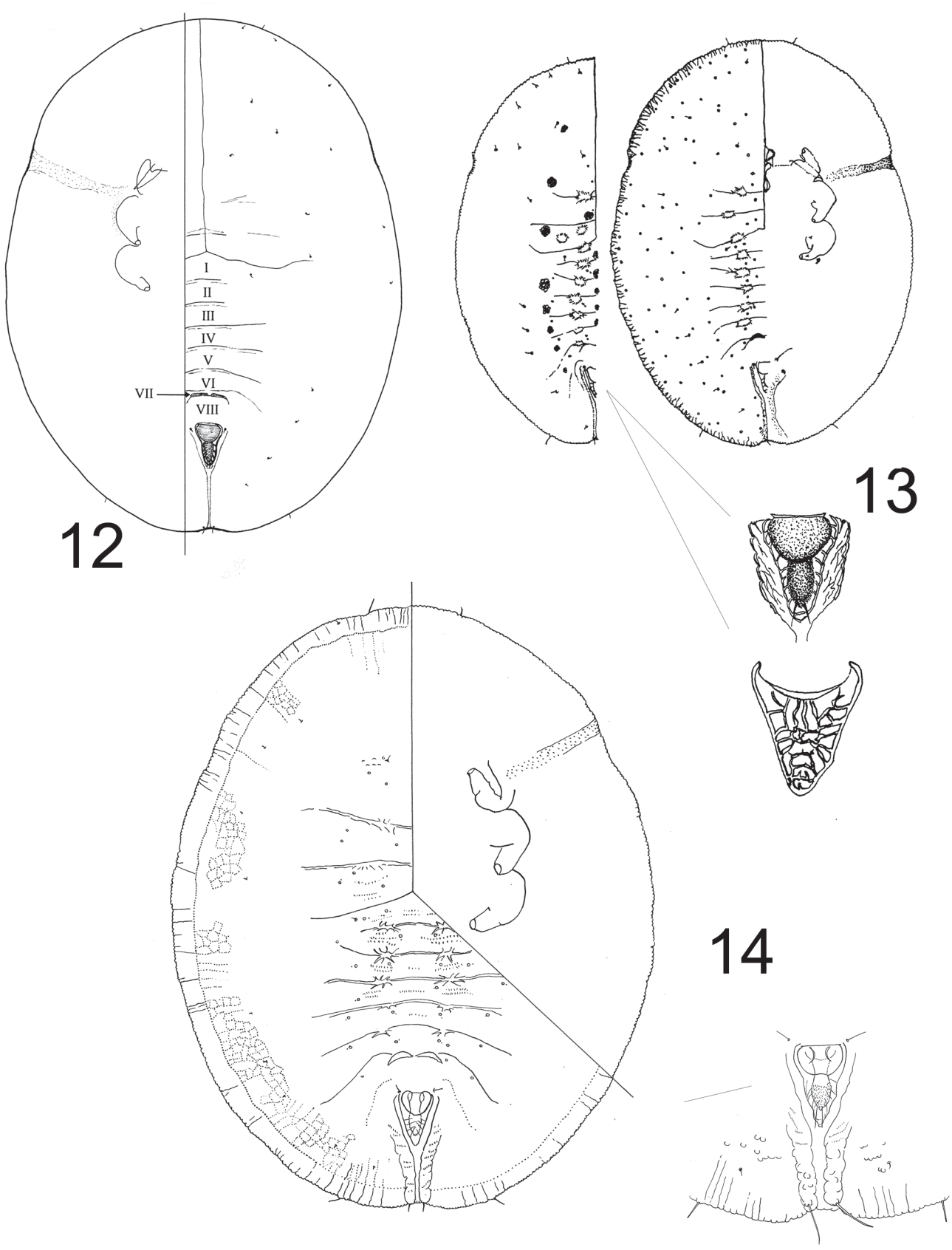
FIGURES 2–5. line drawings of puparia. 2, *Acaudaleyrodes rachipora* (Singh), after Priesner & Hosny (1934a); 3, *Aleurothrixus floccosus* (Maskell); 4, *Aleurotrachelus atratus* Hempel; 5, *Aleurotulus nephrolepidis* (Quaintance)



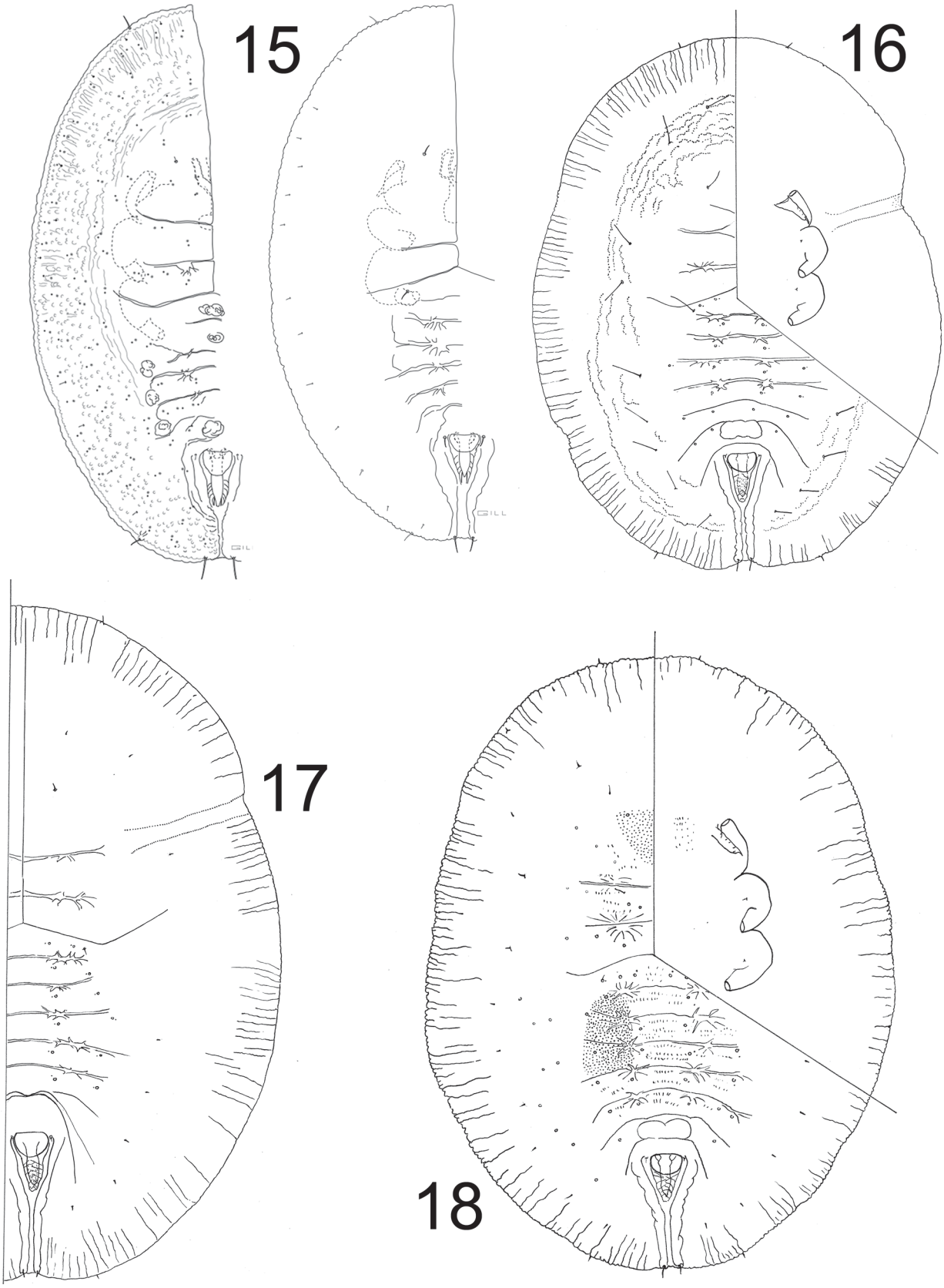
FIGURES 6–9. line drawings of puparia. 6, *Aleyrodes lonicerae* Walker, to show median abdominal segmentation; 7, *Aleyrodes proletella* (Linnaeus); 8, *Aleyrodes laurisilvae* Hernández-Suárez and Martin **sp. nov**.; 9, *Aleyrodes singularis* Danzig, after Martin *et al*., 2000



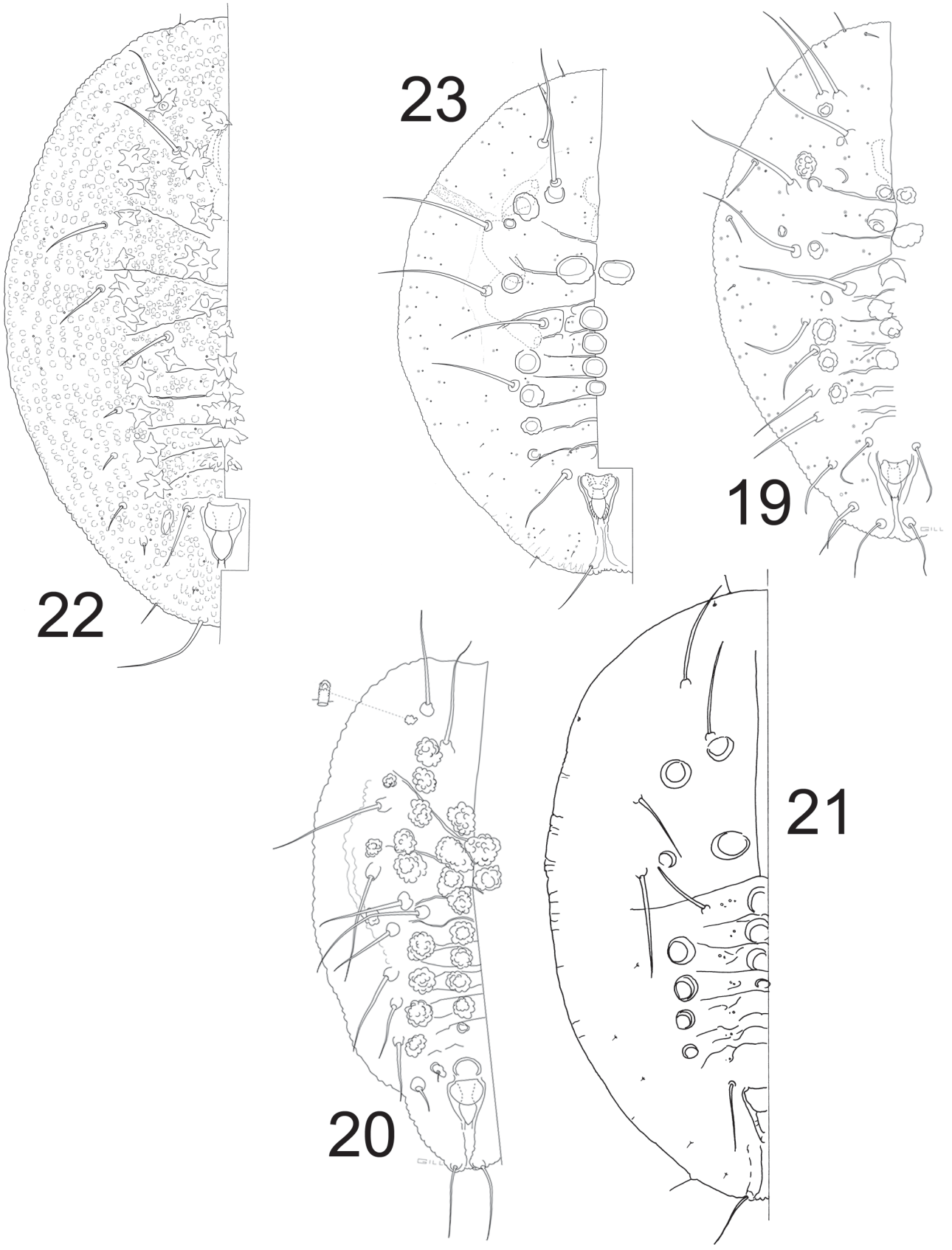
FIGURES 10–11. line drawings of puparia. 10, *Aleyrodes bencomiae* Hernández–Suárez and Martin **sp. nov**.; 11, *Aleyrodes elevatus* Silvestri, after Martin *et al*., 2000



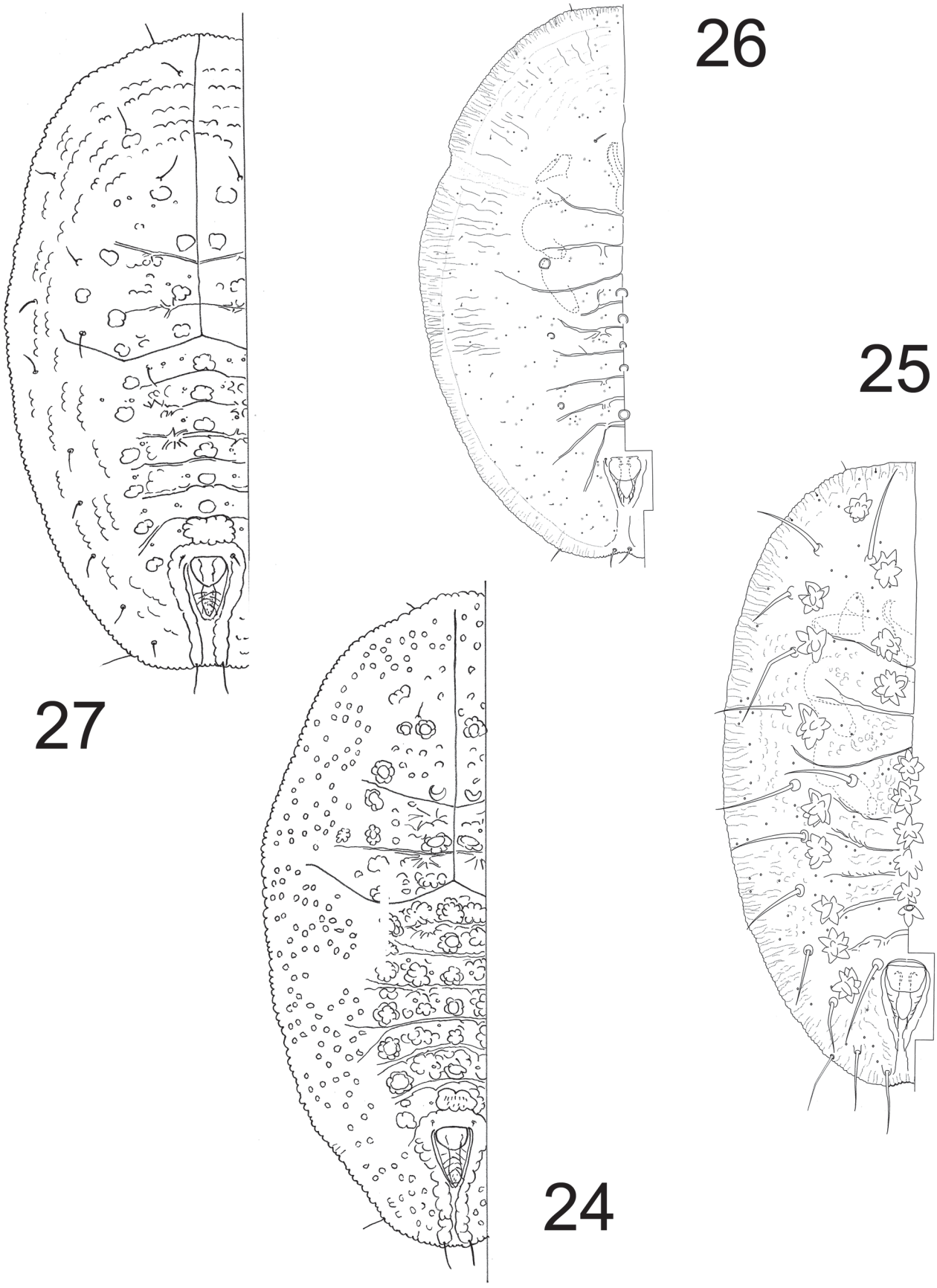
FIGURES 12–14. line drawings of puparia. 12, *Bemisia afer sens. lat*., to show median abdominal segmentation; 13, *Bemisia afer sens. lat*. from Madeira to show variation in single sample; 14, *Bemisia afer sens. lat*. form A



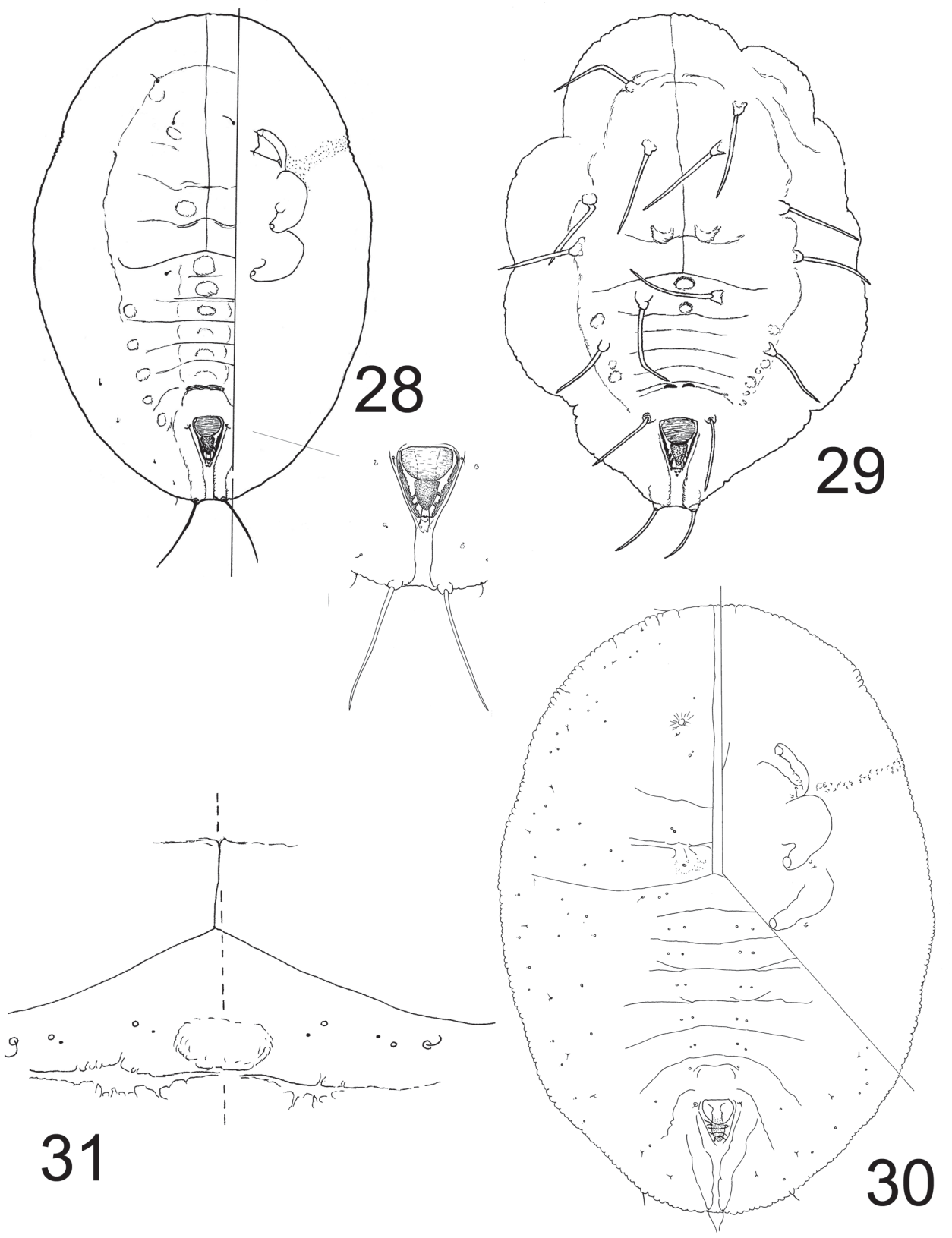
FIGURES 15–18. line drawings of puparia. 15, *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov**., showing upper surface specimen (left) and lower surface specimen (right); 16 & 17, *Bemisia afer sens. lat*. form B; 18, *Bemisia medinae* Gómez-Menor



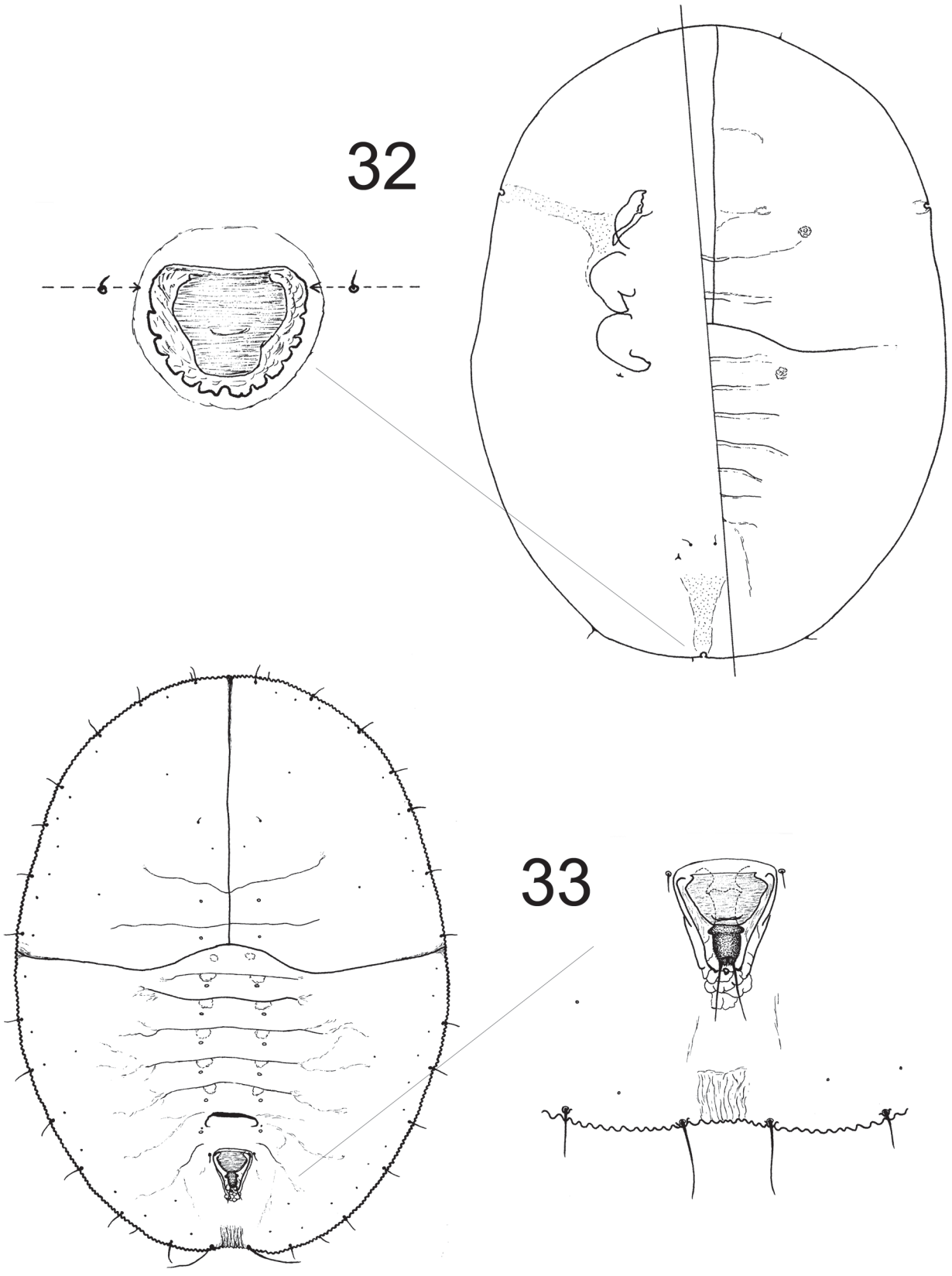
FIGURES 19–23. line drawings of puparia. 19 & 20, *Bemisia afer sens. lat*. form C; 21 & 23, *Bemisia afer sens. lat*. form D; 22, *Bemisia afer sens. lat*. form G



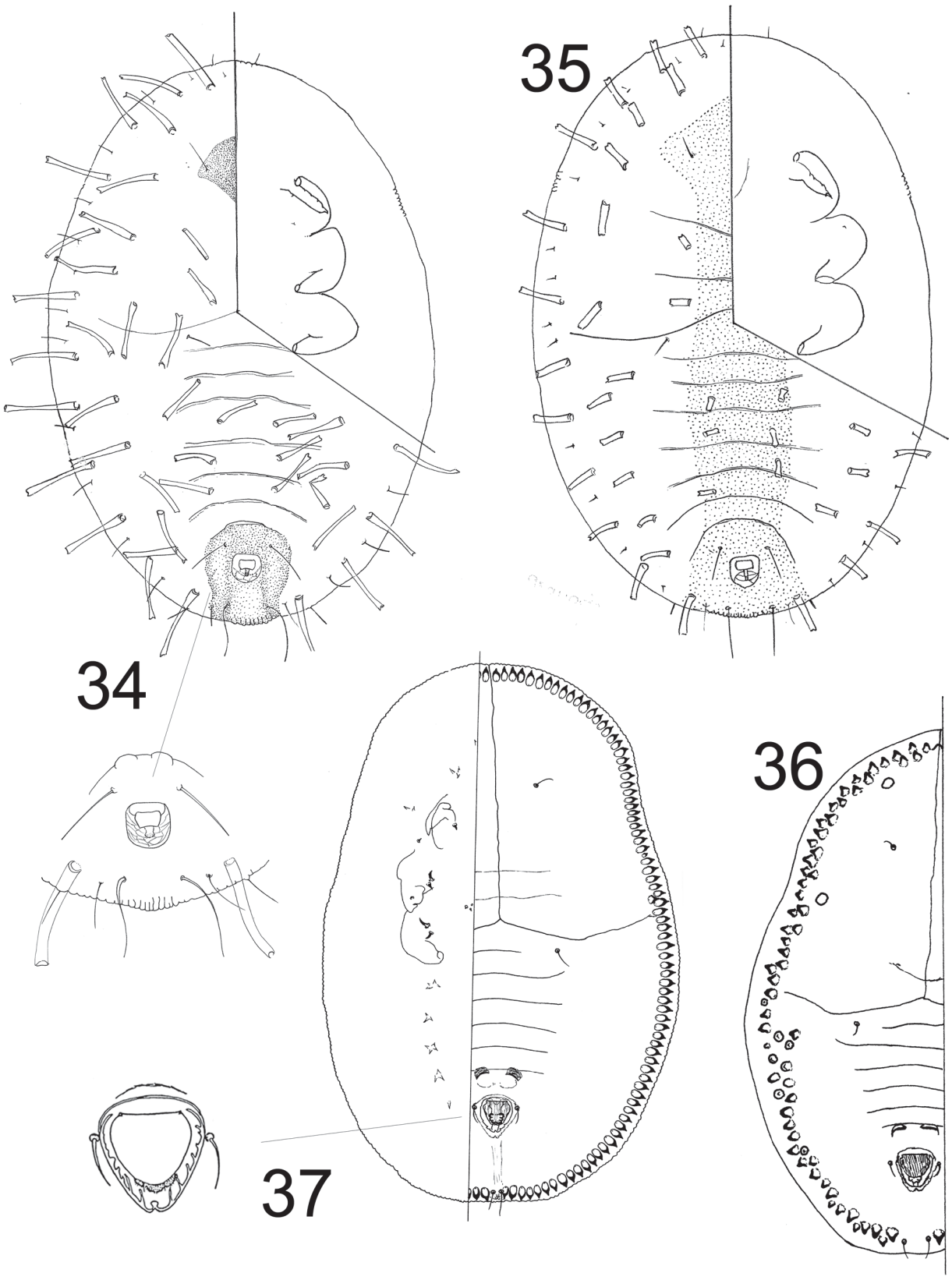
FIGURES 24–27. line drawings of puparia. 24, *Bemisia afer sens. lat*. form E; 25 & 26, *Bemisia afer sens. lat*. form F showing upper surface specimen (26) and lower surface specimen (25); 27, *Bemisia afer sens. lat*. form H



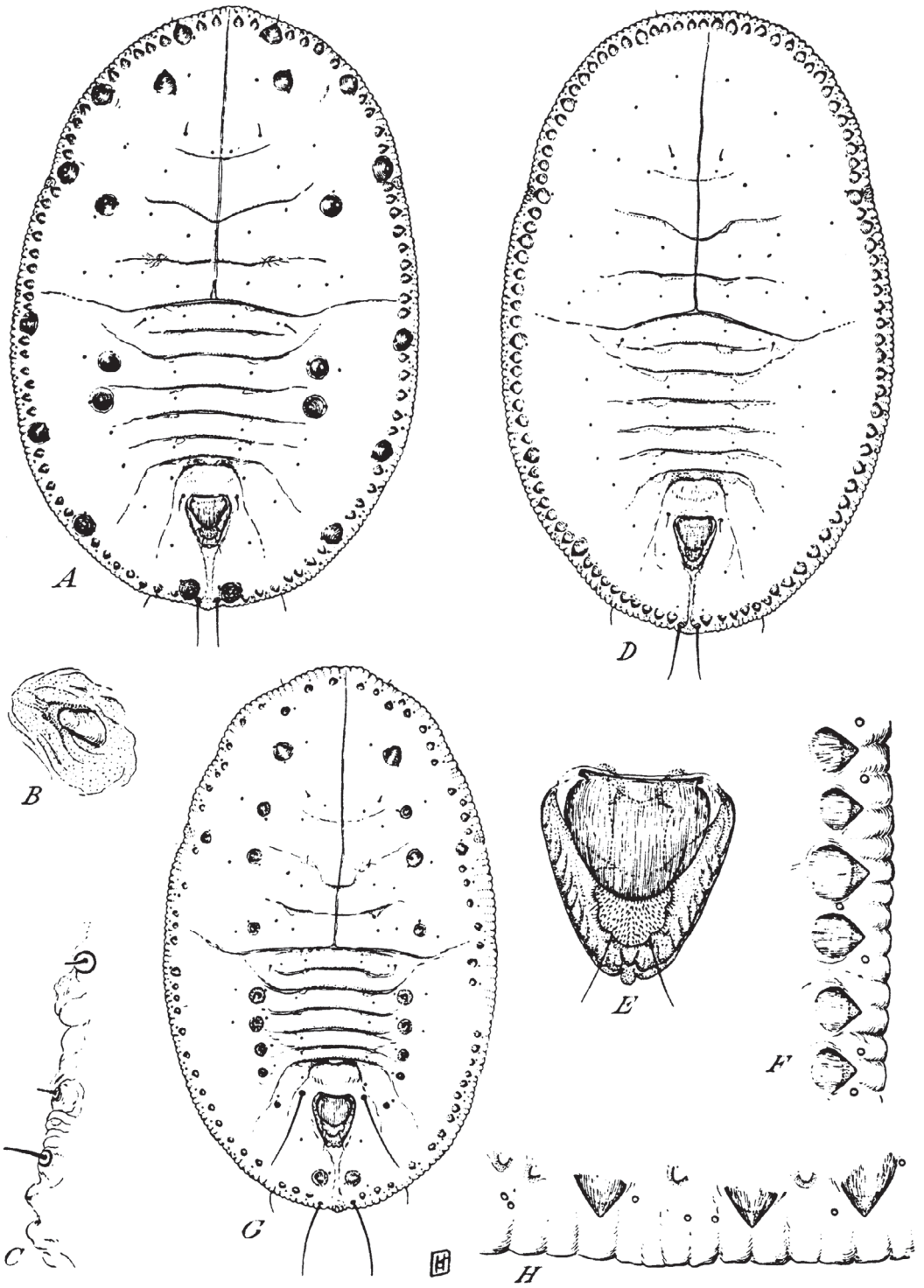
FIGURES 28–31. line drawings of puparia. 28, *Bemisia tabaci* (Gennadius), smooth-leaf form; 29, *Bemisia tabaci* (Gennadius), hairy-leaf form; 30, *Bemisia reyesi* Hernández-Suárez and Martin **sp. nov**., puparium; 31, *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov**., median part of abdominal segment I to show two pairs of geminate pore/porettes on each side of median line, between 1st abdominal setae



FIGURES 32–33. line drawings of puparia. 32, *Dialeurodes citri* (Ashmead); 33, *Parabemisia myricae* (Kuwana)

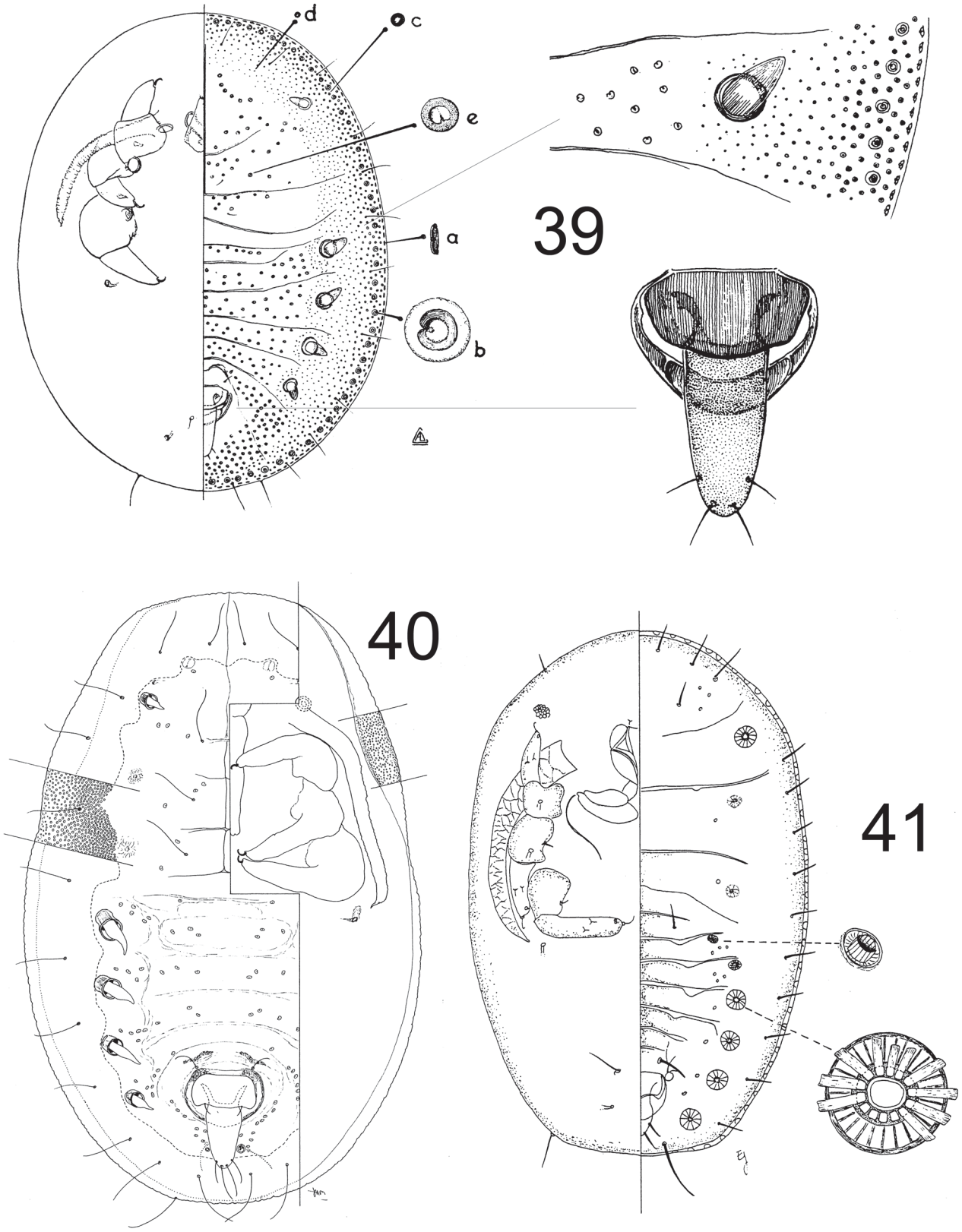


FIGURES 34–37. line drawings of puparia. 34, *Siphoninus finitimus* Silvestri; 35, *Siphoninus phillyreae* (Haliday); 36, *Trialeurodes ricini* (Misra), typical *Ricinus*-feeding form; 37, *Trialeurodes ricini* (Misra), from smooth-leaved host

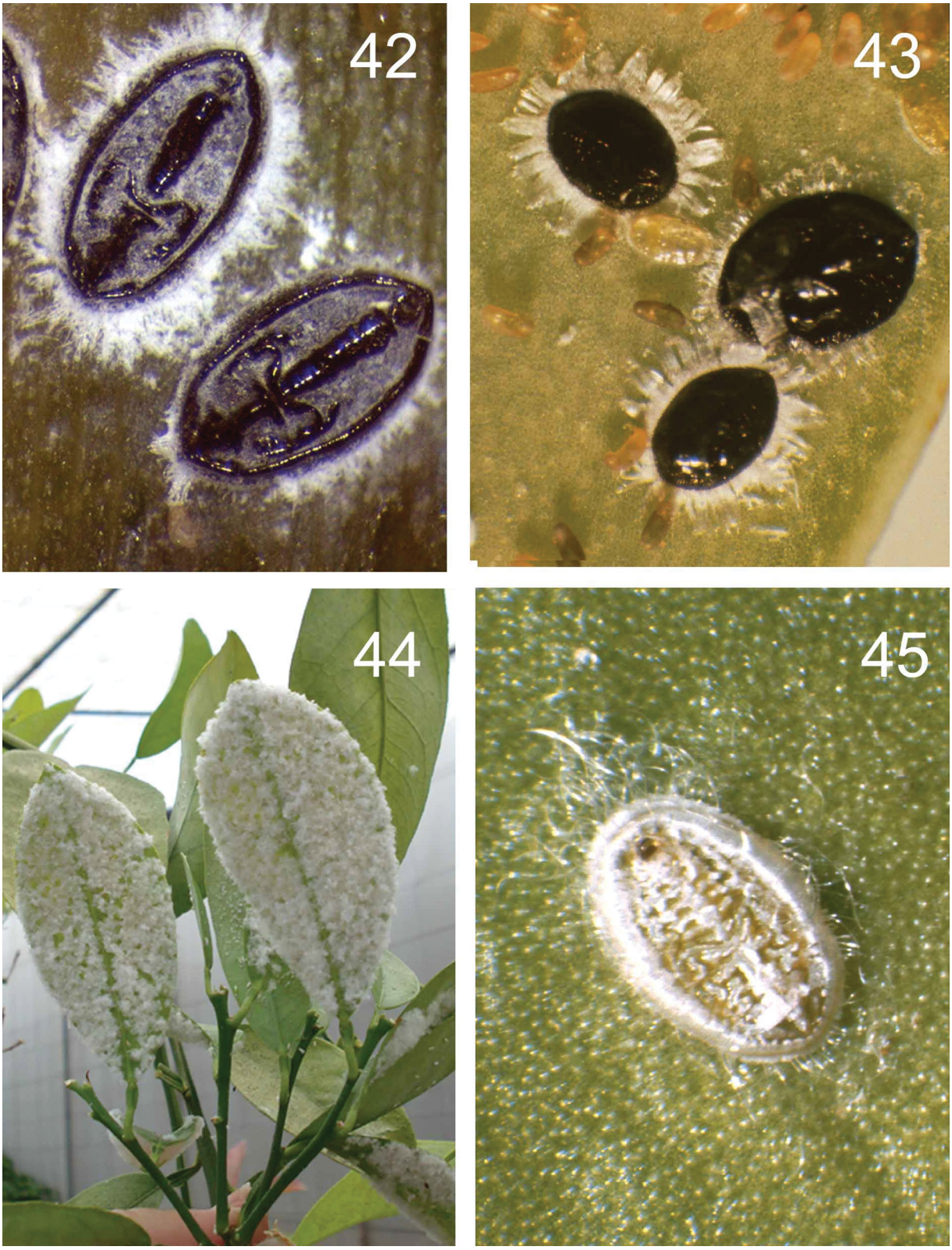


Trialeurodes vaporariorum: *A*, Outline, specimen from moderately hairy leaf; *B*, same, thoracic spiracle; *C*, same, part of inner basal area of middle leg; *D*, outline of specimen from smooth leaf; *E*, same, vasiform orifice; *F*, same, section of margin and submargin; *G*, outline of specimen from very hairy leaf; *H*, section of margin and submargin of a specimen from a smooth, tough leaf showing degenerate papillae and greater width of marginal crenulations.

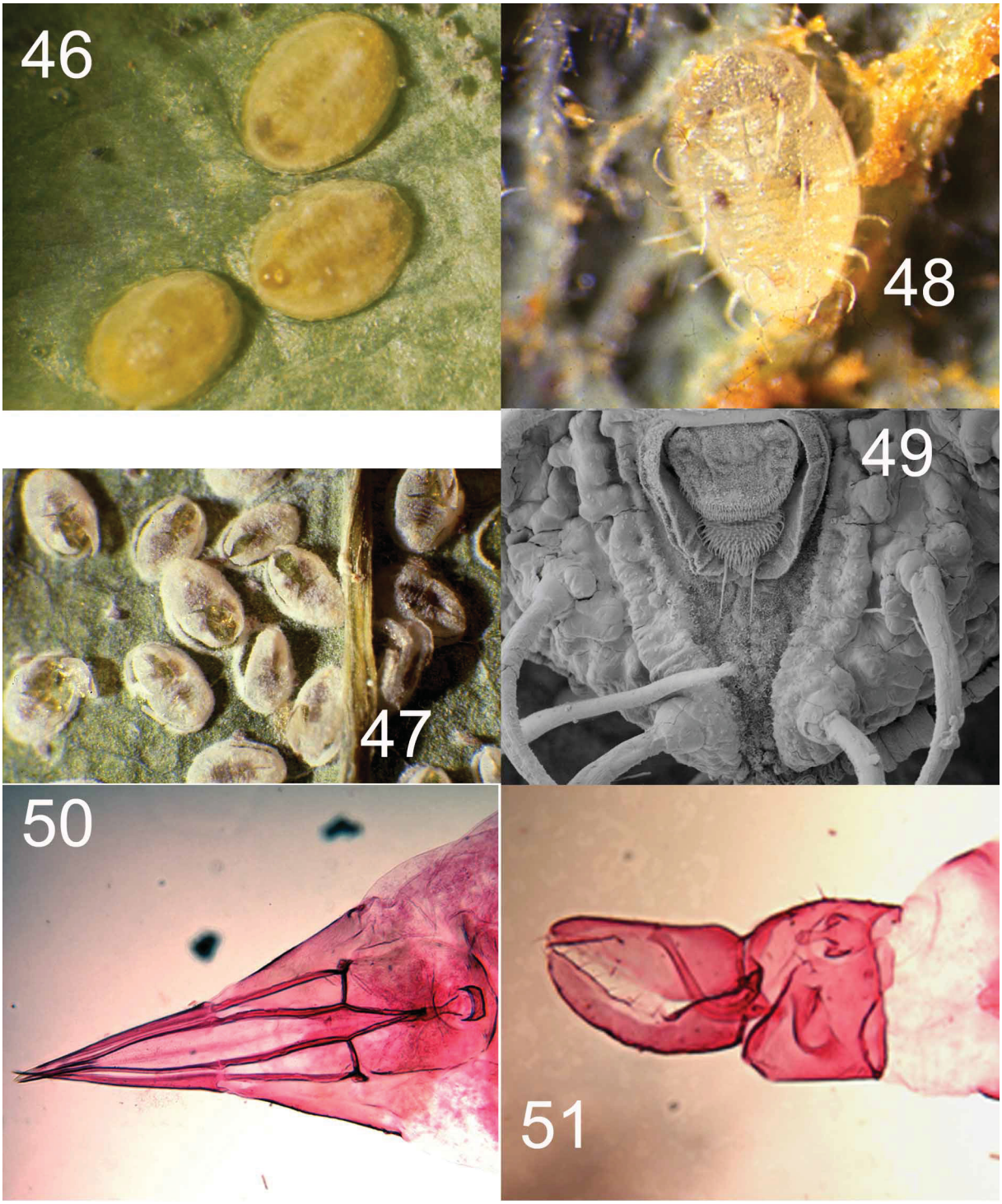
FIGURES 38. line drawings of puparia, *Trialeurodes vaporariorum* (Westwood), original plate and captions after Russell (1948), showing variation



FIGURES 39–41. line drawings of puparia. 39, *Aleurodicus dispersus* Russell, after Russell (1965); 40, *Aleurodicus floccissimus* (Martin, Hernández-Suárez & Carnero); 41, *Paraleyrodes minei* Iaccarino, after Martin *et al*., 2000

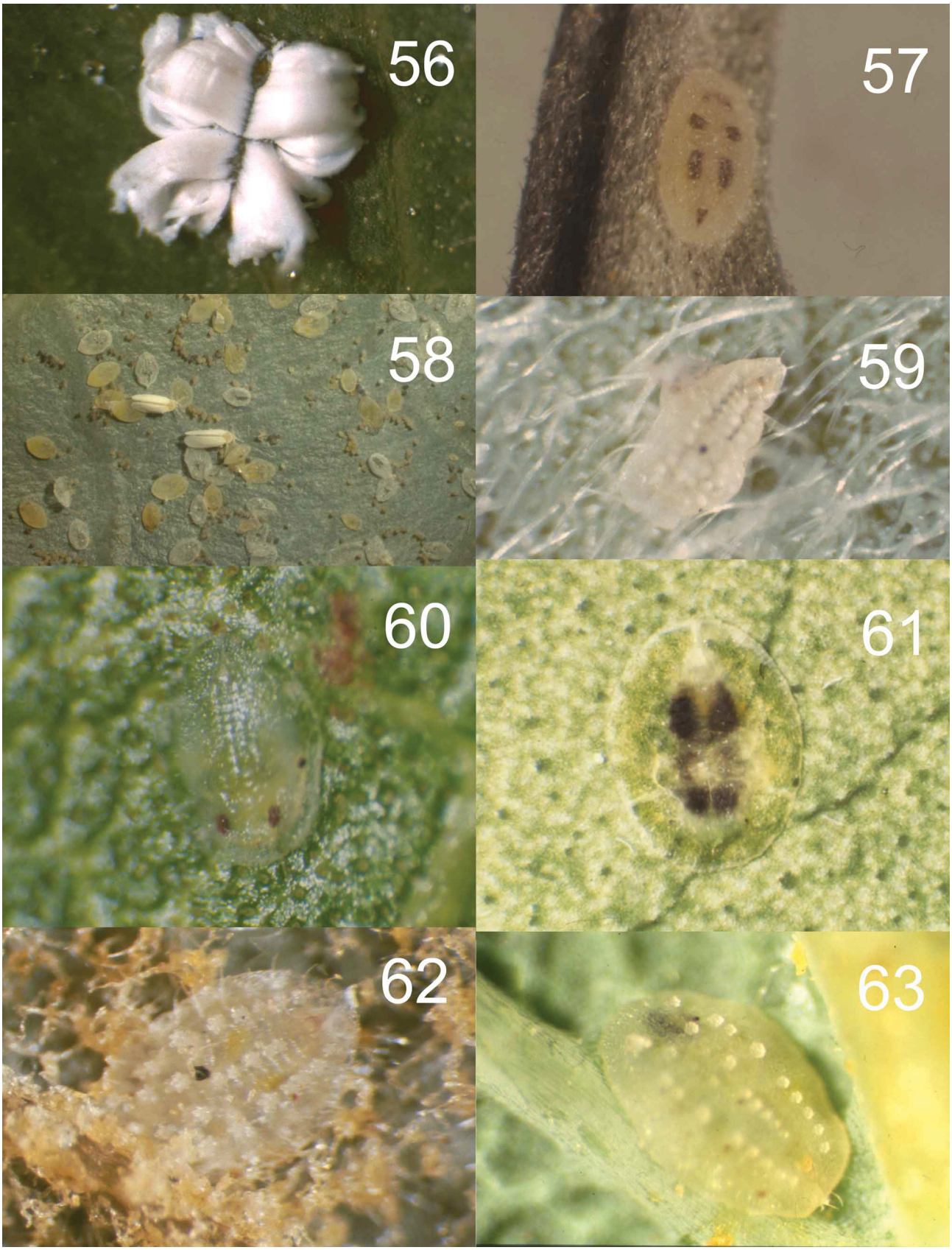


FIGURES 42–45. *habitus* photographs. 42, *Aleurotrachelus atratus* Hempel, puparia; 43, *Acaudaleyrodes rachipora* (Singh), puparia; 44, *Aleurothrixus floccosus* (Maskell), large infestation under leaves; 45, *Aleurothrixus flossosus* (Maskell), puparium



FIGURES 46–51. 46, *Aleyrodes proletella* (Linnaeus), *habitus* photograph, puparia; 47, *Aleyrodes laurisilvae* Hernández-Suárez and Martin **sp. nov**. *habitus* photograph, group of puparia; 48, *Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov**., *habitus* photograph, puparium; 49, *Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov**., SEM image, vasiform orifice, puparium; 50, *Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov**., photomicrograph, abdominal apex, adult female; 51, *Aleyrodes bencomiae* Hernández-Suárez and Martin **sp. nov**., photomicrograph, abdominal apex, adult male.

FIGURES 52–55. *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov**., *habitus* photographs. 52, ovum; 53, newly emerged adult female and vacated pupal case; 54, single puparium with developing adult visible within; 55, group of puparia



FIGURES 56–63. *habitus* photographs. 56, *Bemisia reyesi* Hernández-Suárez and Martin **sp. nov**., puparium; 57, *Bemisia afer sens. lat*. form H, puparium; 58, *Bemisia tabaci* (Gennadius), colony of puparia and adults; 59, *Bemisia afer sens. lat*. form C, puparium; 60, *Bemisia afer sens. lat*. form B, puparium; 61, *Bemisia medinae* Gómez-Menor, puparium; 62, *Bemisia afer sens. lat*. form G, puparium; 63, *Bemisia afer sens. lat*. form F, puparium

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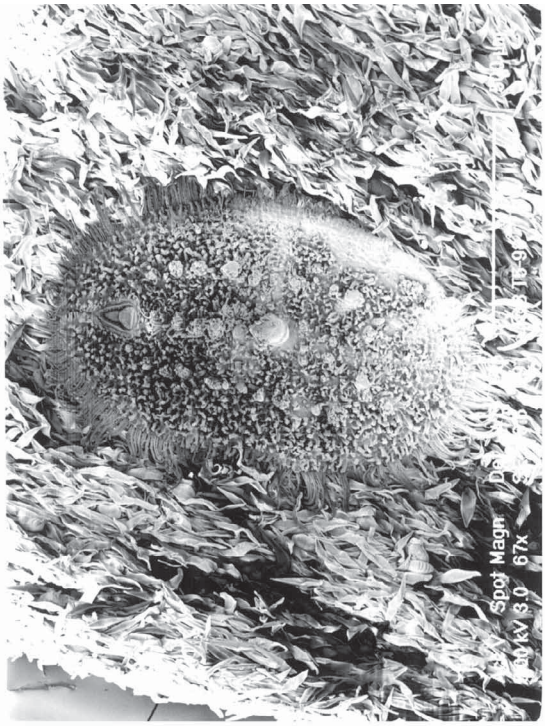

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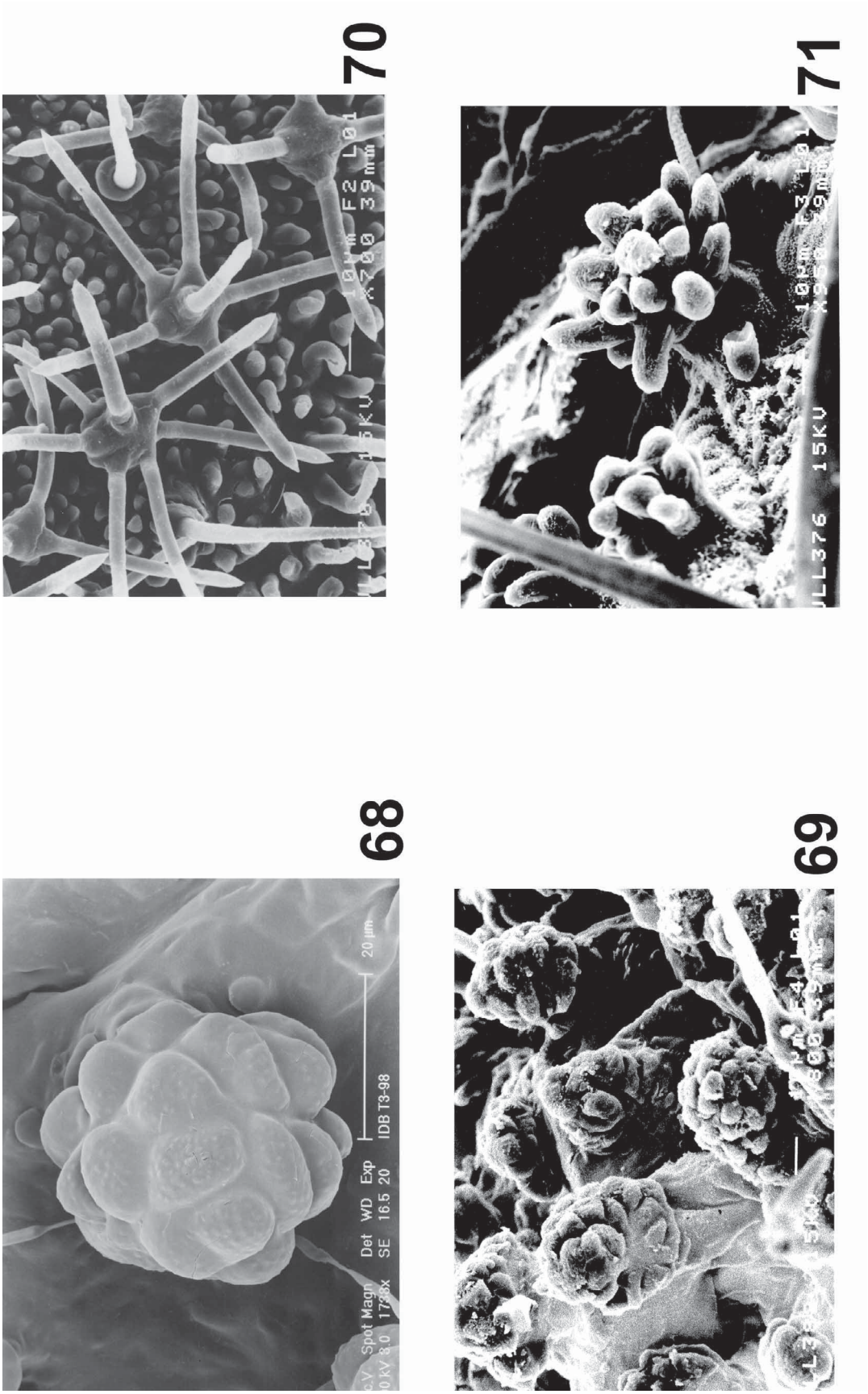
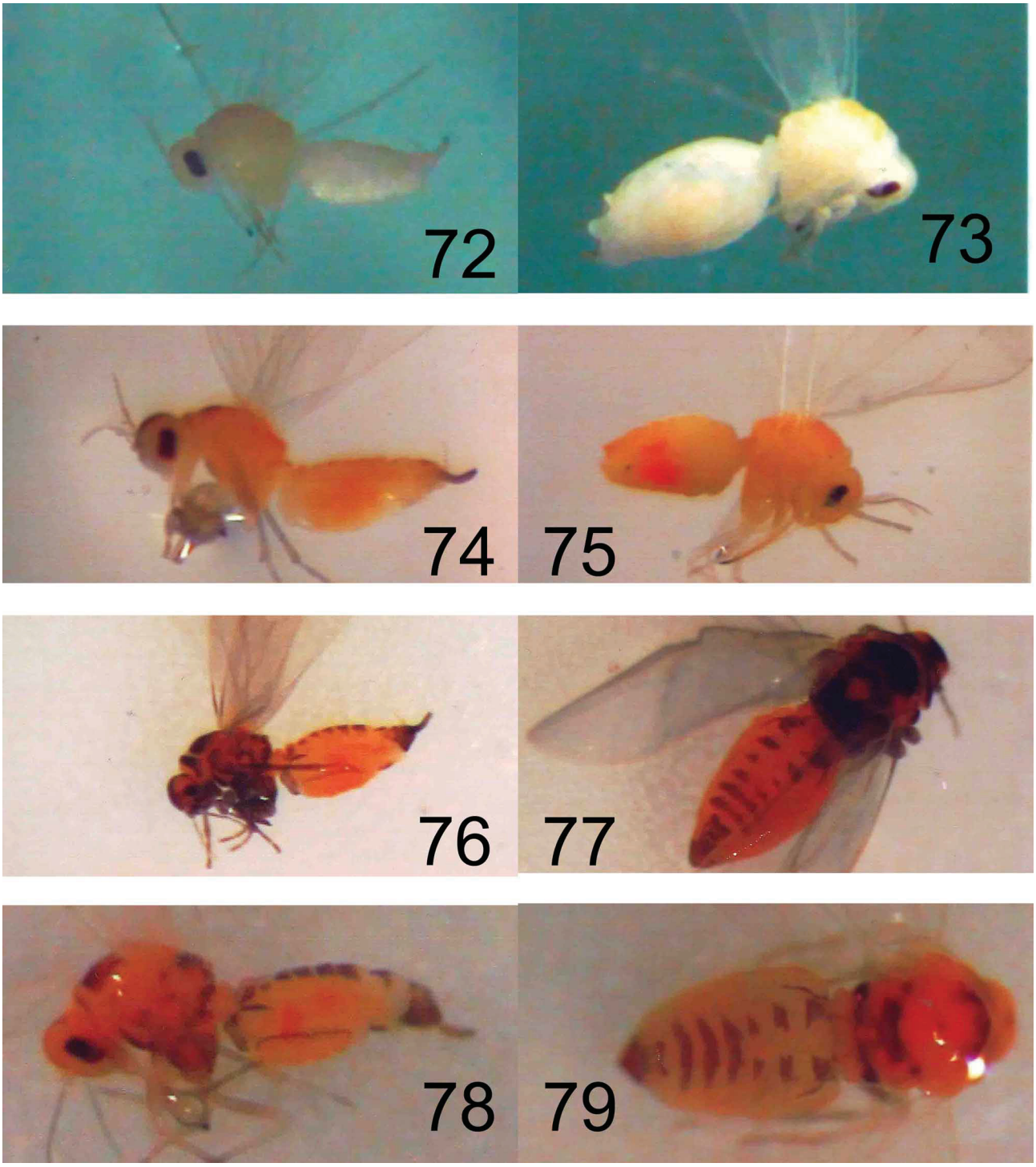
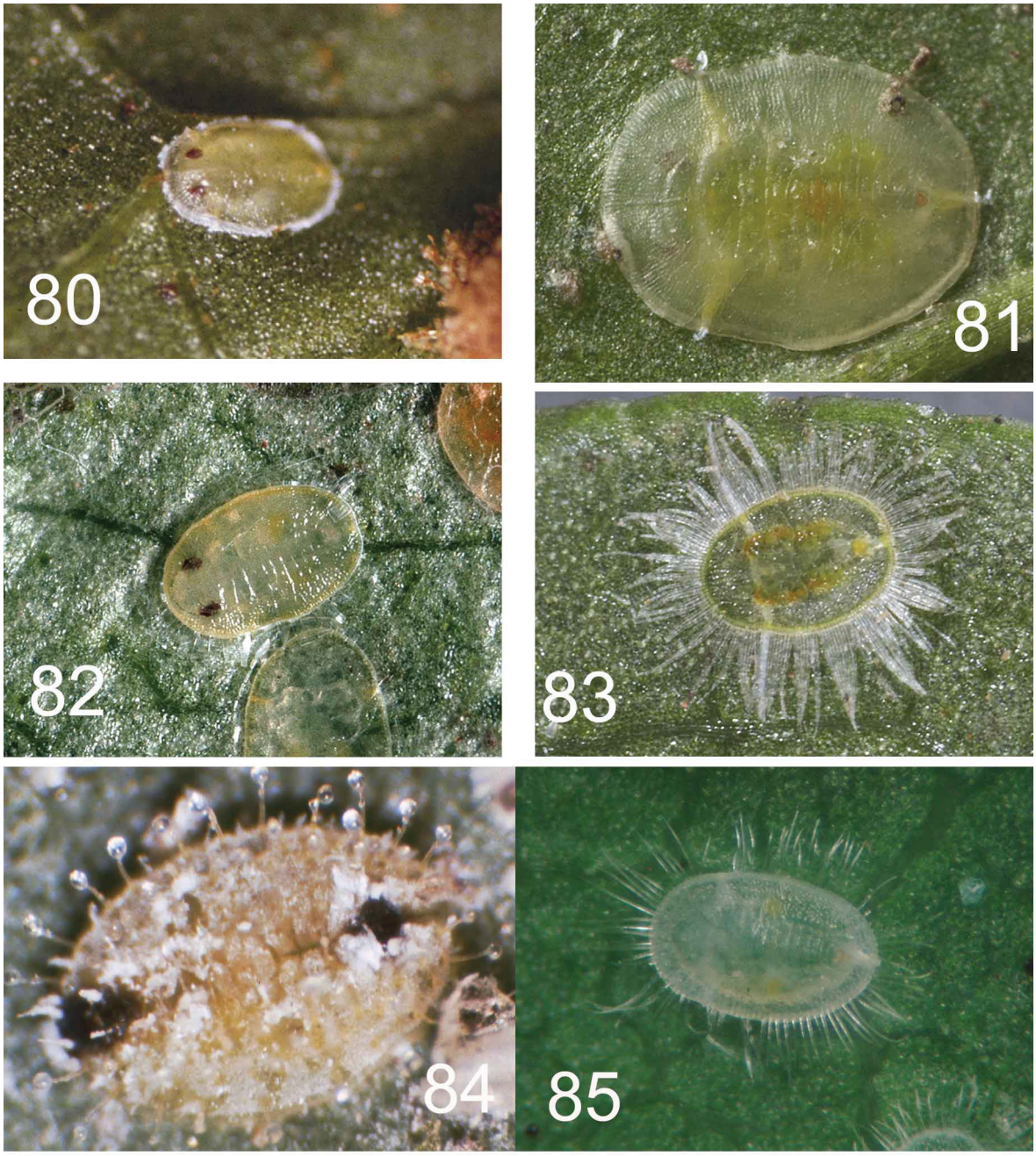
FIGURES 64–67. SEM images, puparia. 64, *Bemisia afer sens. lat*. form C; 65, *Bemisia medinae* Gómez-Menor; 66, *Bemisia afer sens. lat*. form G; 67, *Bemisia afer sens. lat*. form H



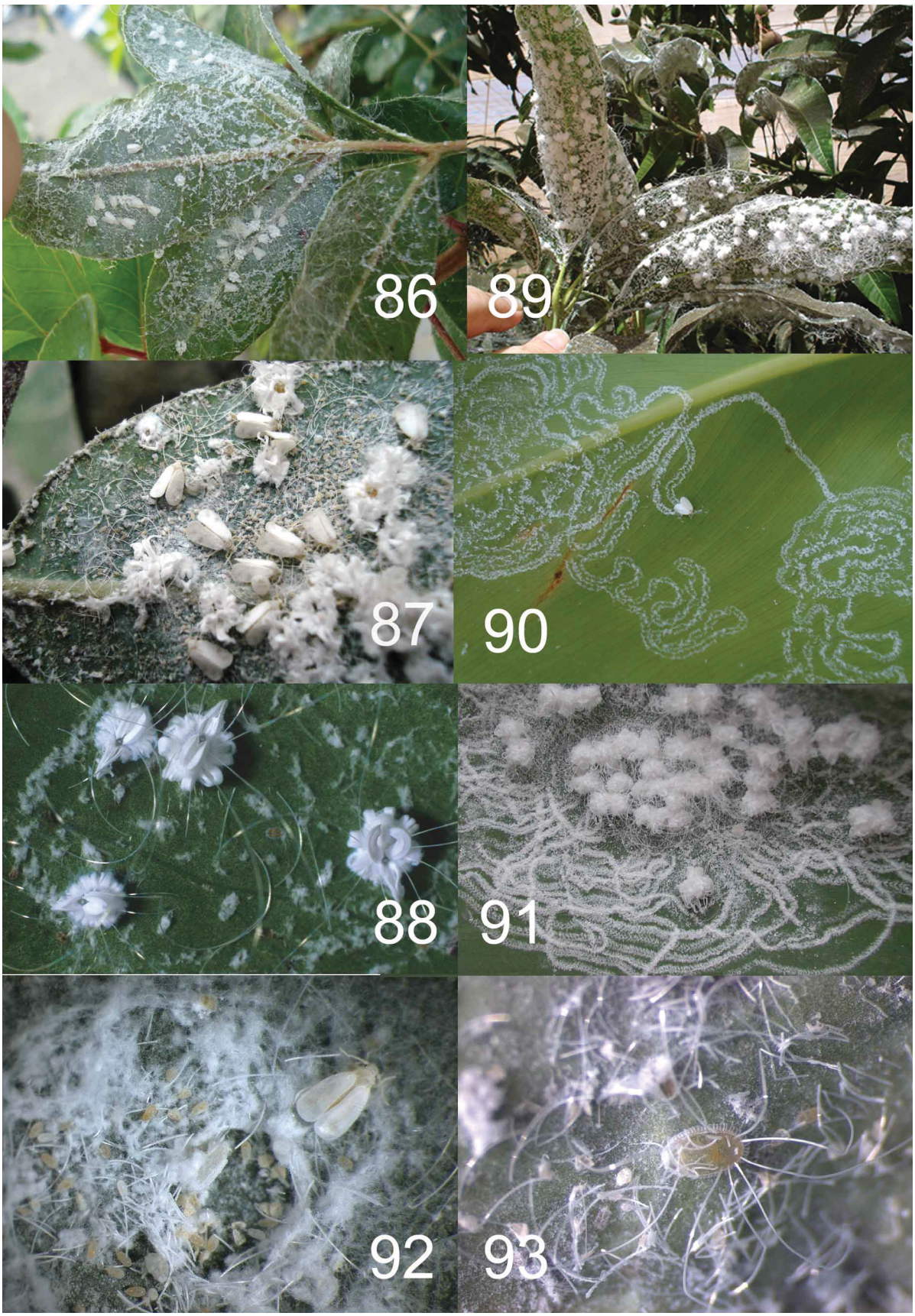
FIGURES 68–71. SEM images, puparia. 68, *Bemisia afer sens. lat.* form F, single dorsal tubercle; 69, *Bemisia afer sens. lat.* form C, group of dorsal tubercles; 70, *Bemisia afer sens. lat.* form G, star-shaped dorsal tubercles; 71, *Bemisia afer sens. lat.* form F, dorsal tubercles



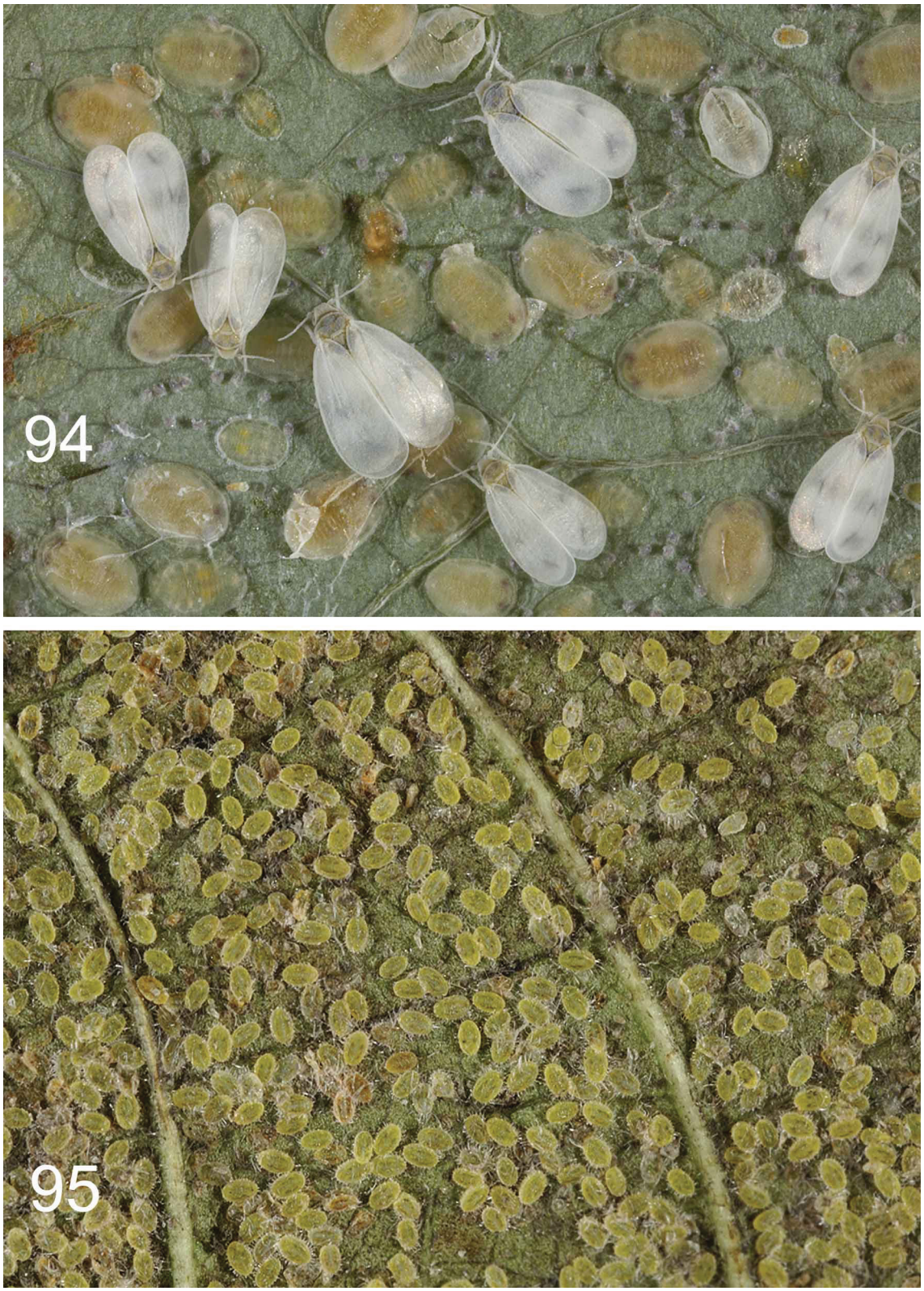
FIGURES 72–79. photographs of adults in alcohol. 72 & 73, *Bemisia medinae* Gómez-Menor; 74 & 75, *Bemisia reyesi* Hernández-Suárez and Martin **sp. nov**.; 76 & 77, *Bemisia euphorbiarum* Hernández-Suárez and Malumphy **sp. nov**.; 78 & 79, *Bemisia afer sens. lat*. form F



FIGURES 80–85. *habitus* photographs, puparia. 80, *Aleurotulus nephrolepidis* (Quaintance); 81, *Dialeurodes citri* (Ashmead); 82, *Parabemisia myricae* (Kuwana); 83, *Trialeurodes ricini* (Misra); 84, *Siphoninus finitimus* Silvestri; 85, *Trialeurodes vaporariorum* (Westwood)



FIGURES 86–93. *habitus* photographs. 86–88, *Aleurodicus dispersus* Russell, groups of adults and puparia, under leaves of hosts; 89–91, *Aleurodicus floccissimus* (Martin, Hernández-Suárez & Carnero), groups of adults and puparia, with egg-laying trails, under leaves of hosts; 92, *Paraleyrodes minei* Iaccarino, adult female with egg nest; 93, *Paraleyrodes minei* Iaccarino, puparium surrounded by secreted filaments



FIGURES 94–95. Habitus photographs. 94, *Aleyrodes proletella*, colony of puparia and emergent adults, with two vacated pupal cases. 95, extremely large colony of *Trialeurodes ricini* on *Ricinus communis*, Gran Canaria.